GenRad

INSTRUCTION MANUAL

Type 1062
Frequency Synthesizer

B

Warranty

General Radio

This product is warranted to be free from defects in material and workmanship and, when properly used, will perform in accordance with specifications. Any GR-manufactured instrument, module, or part found not to meet this standard within a period of one year after original shipment will be repaired or replaced at no charge when returned to a GR service facility.

GR policy is to maintain repair capability for a period of ten years after the original shipment and to make this capability available at the then prevailing schedule of charges for any product returned to a GR service facility. Changes in the product not approved by GR shall void this warranty. GR is not liable for consequential damages.

This warranty is in lieu of all other warranties, expressed or implied, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose.

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Type 1062 Frequency Synthesizer

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ID-0100

SPECIFICATIONS

Fixed Frequency: 10 kHz to 499.99 MHz in 10-kHz steps with 100-Hz search-sweep settability. Finer steps optional, the finest being 0.1-Hz steps with 0.001-Hz search-sweep settability. LOCAL CONTROL (Option 1): Set by in-line-readout panel switches or external remote-control signals; control transferred by single panel control. REMOTE CONTROL: Set by 8-4-2-1 external signals; logic "1" is 0 to 0.5 V at 3 mA, logic "0" is +5 V at 0 mA. PROGRAMMING TIME: Less than 50 μs to be within 500 Hz (worst case) of any new frequency selected. (Data for frequency error vs time are shown in the accompanying table.)

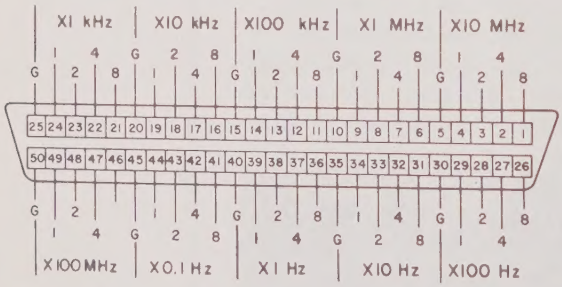
Frequency Error Vs Time after Switching

(For Output Levels ≥ +10 dBm)

	Digit Switched			
Time	100 MHz	10 MHz	1 MHz	100 kHz or Less*
50 μs	500 Hz	50 Hz	10 Hz	1-MHz error x
100 μs	150 Hz	5 Hz	1.5 Hz	digit switched
1 ms	3 Hz	<0.1 Hz	<0.1 Hz	(in MHz)

*Below 1 MHz each digit has 1/10 the error of the adjacent higher digit.

Search-Sweep and Frequency Modulation: SWEEP WIDTH: Up to 11 MHz. Any decade, with steps of 1 MHz or less, can be converted to continuous control with a range of −1 to +10 X one step of the decade being replaced, with a settability of 1/100 of one step. LOCAL CONTROL (optional): Digit to be replaced is chosen by panel pushbuttons or external signal; frequency is set by −1 to +10 multiplier plus continuous vernier or by external signal. REMOTE CONTROL: Digit to be replaced is chosen by logic signal; frequency is set by +0.5V/step (−0.5 to +5.0 V) dc signal with nonlinearity of ±0.3 step max. SWEEP (FM) RATE: Dc to 20 kHz, −3 dB. DEVIATION: Pk-pk inside 0- to 9-digit range. DISTORTION: 3% at 5 kHz, 6% max. STABILITY: $\pm 2 \times 10^{-4}$ step/second, $\pm 1 \times 10^{-3}$ step/min, $\pm 1 \times 10^{-2}$ step/h after 2-h warmup.

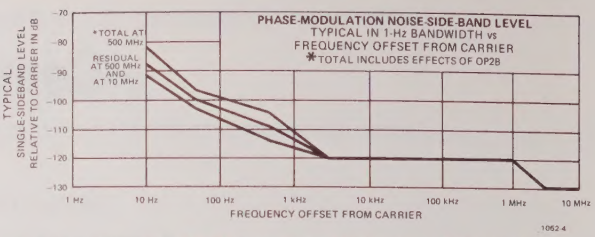


Frequency Programming Connector

Amplitude Modulation (at <5% distortion):

	Carrier Frequency		
Carrier Level	10kHz to 100kHz	100kHz to 400kHz	400kHz to 500MHz
+7 dBm	90%, up to 100-Hz rate	90%, up to 1-kHz rate	90%, up to 4-kHz rate
+10 dBm	50%, up to 200-Hz rate	50%, up to 2.5-kHz rate	35%, up to 10-kHz rate

Signal Output Level: 100 mV to 1 V rms (−7 to +13 dBm into 50 Ω) from 50-Ω source, available at rear GR874® connector (optionally on front panel). LOCAL CONTROL (optional): Set by panel control with ±1.5-dB accuracy or by external remote-control signal. REMOTE CONTROL: Set by external dc signal of 4 X desired rms output voltage, into 1 kΩ applied to rear BNC connector. Programming time < 100 μs, to within ±1 dB of desired level. FLATNESS: ±0.6 dB referred to full output at 100 MHz. HARMONICS: <−25 dB at 10-dBm output into 50-Ω load (typically <−30 dB). DISCRETE NON-HARMONICS: <−80 dB. RESIDUAL PHASE-NOISE MODULATION, rms (also see curve). <−60 dB re 1 radian in 0.5 Hz-to-15 kHz bandwidth. AMPLITUDE-NOISE MODULATION, rms: <−75 dB re 100% carrier in 0.5 Hz-to-15 kHz bandwidth.



Auxiliary Outputs: 10 MHz at +6 to +8 dBm into 50 Ω (will drive another synthesizer) and 1 MHz at 0.8 V pk-pk into 10 kΩ, from rear BNC connectors. 42 MHz at −4 to −1 dBm, 1770 to 2170 MHz at −1 to +3 dBm, 2270 to 2180 MHz at −3 to +2 dBm, 500 to 510 MHz at −15 dBm, all into 50 Ω from rear SMA connectors.

Phase Modulation: Output can be phase modulated ±3 rad at rates from dc to 300 kHz (±1 rad at 1-MHz rate), by external signal of 1 V/rad at dc, flat within 2 dB to 300 kHz, into 7.5 kΩ, applied to rear BNC connector. Distortion at ±3 rad is −25 dB to 300 kHz and at ±1 rad is −35 dB to 100 kHz, −30 dB to 300 kHz, and −25 dB to 1 MHz.

Accuracy of Fixed Frequency: Equal to that of drive source. Drive source can be internal oscillator or external drive.

Internal Oscillator (optional): MODERATE STABILITY: 5 MHz crystal oscillator. Adjustment range $>5 \times 10^{-5}$ by manual trimmer or $>5 \times 10^{-6}$ by +6- to +9-V external dc signal. Stability is 2×10^{-7}/°C from +20 to +50°C, 2×10^{-6}/mo. HIGH STABILITY: 10-MHz crystal oscillator in proportional-control oven. Adjustment range, $>4 \times 10^{-6}$ by manual trimmer or $>5 \times 10^{-7}$ by +6- to +9-V external dc signal. Stability, $<2 \times 10^{-10}$/°C from 0 to +50°C. Drift, $\pm 1 \times 10^{-8}$/wk, $\approx 1 \times 10^{-9}$/day after 1 month of continuous operation, $<2 \times 10^{-10}$ with ±10% line-voltage variation, restabilizes within 2 h after power interruption. Connector provided on rear for battery to maintain oscillator during power interruption.

External Drive (required on models without internal oscillator): 5 or 10 MHz, 130 mV to 2.5 V rms into 50 Ω applied to rear BNC connector.

Environment: TEMPERATURE: 0 to +50°C operating.

Supplied: Power cord, coaxial patch cord with GR874 connectors, 50-pin plug to mate with rear connector.

Available: GR874 adaptors, 1062-P1 Tracking Synthesizer, 1167 Frequency Programmer.

Power: 90 to 110, 104 to 127, 180 to 220, 194 to 236, or 207 to 253 V; 48 to 66 Hz (45 to 48 Hz with high-line limit decreased 5%, 360 to 440 Hz with low-line limit increased 5%); 85 W max. Connection provided for 15- to 18-V, 200-mA, dc source to maintain high-stability oscillator during power interruption.

Mechanical: Bench or rack models. DIMENSIONS (wxhxd): Bench, 19.75x6.9x24.88 in. (502x176x632 mm); rack, 19x5.22x22.38 in. (483x133x569 mm). WEIGHT: Bench, 63 lb (29 kg) net, 74 lb (34 kg) shipping; rack, 55 lb (25 kg) net, 66 lb (30 kg) shipping.

Description
1062 Frequency Synthesizer, 10 kHz to 500 MHz with 10-kHz resolution and 100-kHz search settability, remote control, and external drive only
Bench Model
Rack Model
Select following options, if desired
OP1 Local Control Panel
OP2A Moderate-Stability Internal Oscillator
OP2B High-Stability Internal Oscillator
OP4A 1-kHz digit resolution (10-Hz search)
OP4B 100-Hz digit resolution (1-Hz search)
OP4C 10-Hz digit resolution (0.1-Hz search)
OP4D 1-Hz digit resolution (0.01-Hz search)
OP4E 0.1-Hz digit resolution (0.001-Hz search)

Introduction—Section 1

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1.1 GENERAL.

The Type 1062 Frequency Synthesizer generates highly stable, accurate frequencies from .01 to 500 MHz at an output level of −7 to +13 dBm. The output frequency is derived from a single source by a series of arithmetic operations on frequency (addition, subtraction, multiplication, and division). Phase-locked oscillators are used for stepped-digit frequency selection, except for the 100 MHz steps, where a drift-canceled varactor-tuned oscillator is used.

A continuously adjustable decade, hereafter referred to as CAD, is a built-in feature. The frequency of the selected decade is continuously variable or programmable from −1 to +10 digits. Any decade 1 MHz and smaller can be "searched" via an external analog voltage. Remote selection of the searched decade is accomplished by programming a 10 in BCD (8 + 2) for that particular decade.

Signal-to-phase-noise ratio is greater than 60 dB for a noise bandwidth that extends from 0.5 Hz to 15 kHz on each side of the output frequency. The signal-to-amplitude-noise ratio is 75 dB for the same noise bandwidth. Frequency programming, at switching speeds of less than 50 μs per digit, is easily accomplished with BCD control signals.

This synthesizer is structured to permit custom tailoring for a particular need via performance-level and frequency-resolution options. The basic instrument has 10-kHz resolution, a sweep/search capability, programmability, phase-modulation capability, requires an external reference oscillator, and has a blank front panel (no means of local control). Option 1 is a local-control feature (i.e., a full complement of front-panel, rotary-in-line switches for manual control of output frequency), pushbutton search access with manual continuously variable search controls, and manual control of output level. Option 2A is a room-temperature reference oscillator; 2B is a precision reference oscillator. Options 4A through 4E provide a choice of 5 resolutions with 50 μs programming-response time.

A variety of applications exist for the synthesizer in advanced communications, spectrum analysis, physical, medical, and other areas of research. Applications information available upon request to General Radio Company.

1.2 DESCRIPTION

1.2.1 Electrical.

Instead of substituting a variable oscillator for a decade digit, as many other synthesizers do, the 1062 uses its oscillators in an unlocked mode to superimpose a variable-frequency component on the output of a selected digit.

Any decade with 1 MHz and smaller steps can be "searched" via an external analog voltage. The frequency of the selected decade is continuously variable from its −1 to +10 digit. The voltage required varies from −0.5 V to +5 V for the −1 to +10 digit range. When the 10-kHz/step decade is "searched", the basic 1062 has 100-Hz settability.

In other words, the search feature extends the resolution (settability) of the synthesizer to 1% of the smallest decade step.

The (remote) selection of the decade "searched" is accomplished by programming 8 + 2 in BCD for the particular decade.

With the FREQUENCY SELECT control set to LOCAL (option-1 instrument) the output frequency is selected by the front-panel controls. In the REMOTE position, frequency selection is parallel 8-4-2-1 binary-coded decimal (search: 8 + 2). Negative logic is used and the logic levels are: 0 = 5 V at 0 mA; 1 = 0 to 0.5 V at 3 mA. These levels are compatible with standard TTL integrated logic circuits.

For the basic instrument the −7 to +13 dBm output is controlled via a rear-panel BNC input, and leveled to within ±0.6 dB. The RMS output level is related to the program voltage by a factor of 1/4. For example, a voltage of 4.0 V will produce an output of 1.0 V rms or +13 dBm (1.0 V into 50 Ω is +13 dBm).

For option-1 instruments, the output level is 0.1 to 1.0 V (−7 to +13 dBm) from a 50-Ω source impedance. It is available at a front- or rear-panel GR874® recessed locking coaxial connector. The level is continuously adjustable over a 20-dB range providing ±1.5 dB accuracy. At full output the response is flat within ±0.6 dB.

An external source is required to drive the basic (or slave-version) instrument. It can be a synthesizer containing option 2A or 2B, or any other precision 5- or 10-MHz source. Any number of slave synthesizers can be cascaded, if the first one is driven by a suitable external source.

An instrument containing option 2A has a room-temperature reference oscillator with a stability factor of $2 \times 10^{-7}/°C$ from 20°C to 50°C. The electrical adjustment range is 5×10^{-6} from +6 to +9 Vdc. If better accuracy is required, this oscillator can be switched out and replaced by an external source.

An instrument containing option 2B has a precision reference oscillator with a stability factor of $2 \times 10^{-10}/°C$ from 0°C to 50°C. The electrical adjustment range is $> 5 \times 10^{-7}$ from +6 to +9 Vdc. Drift is $\leq 1 \times 10^{-8}$/week; approximately 1×10^{-9}/day after 1 month of continuous operation. Within 2 hours after a power interruption, the oscillator will restabilize typically to within 1×10^{-8}. This unit can also be switch substituted.

The external source referred to above must be either 5.0 or 10.0 MHz and its level 0.13 to 2.5 V (−5 to +21 dBm) into 50 Ω. A rear-panel BNC jack provides the connection.

A rear-panel input (labeled PHASE MOD IN) is used to allow modulation of the carrier. Phase modulation is a type of fm where the frequency deviation and the rate are interdependent. In other words, the frequency and amplitude of the modulating signal determine the fm deviation. The relationship is dependent upon the phase-modulation characteristics. For example, the output can be phase modulated ±3 radians from dc to 300 kHz. In terms of fm, this means that if you modulate with a 1-kHz signal (rate) at the maximum ±3-V amplitude, the equivalent fm deviation is ±3 times 1 kHz or ±3 kHz.

General Radio Company encourages the purchase of option 4A initially. It includes the appropriate mother board to facilitate adding more resolution later without returning the instrument to the factory. Digital-insertion kits are available for this purpose.

It is probably obvious that the resolution options are cumulative. A 1-Hz resolution synthesizer (option 4D) contains the 10-Hz, 100-Hz, and 1-kHz options.

1.2.2 Mechanical.

Large in-line numerals behind windows in the front panel indicate the manually-selected frequency (OP1).

The instrument is available in either a bench cabinet or an EIA standard RS-310, 19-in. relay rack. Mounting instructions are given in Section 2 and include converting from one model to the other.

1.3 CONTROLS, INDICATORS, AND CONNECTORS.

Tables 1-1 and 1-2 list and describe the front- and rear-panel controls, indicators and connectors. Refer to the illustrations of Figures 1-1 and 1-2.

1.4 SYSTEMS.

Since additional equipment can expand the basic capabilities of most General Radio instruments, including the synthesizer, arrangements are available to supply complete systems; inquiries are invited. Each system, custom tailored to individual requirements and including only the equipment necessary to perform the required task, is completely assembled and checked as a unit. Such systems have wide application and can be used for laboratory development, production monitoring, final quality assurance, production-lot sorting, incoming inspection, environmental testing, reliability evaluation, etc., on an automatic or semi-automatic basis.

1.5 ACCESSORIES SUPPLIED.

Table 1-3 lists the accessories supplied with the Synthesizer.

1.6 ACCESSORIES AVAILABLE

1.6.1 Frequency Programmer — Type 1167.

The GR 1167 Frequency Programmer accepts and stores 2 digital words from a serial keyboard entry, which can be used to supply the frequency-program input to the 1062 or similar frequency synthesizers, to provide both fixed and digitally swept frequency outputs. An output-level-setting potentiometer is included, providing complete manual control of even remote-only synthesizer versions.

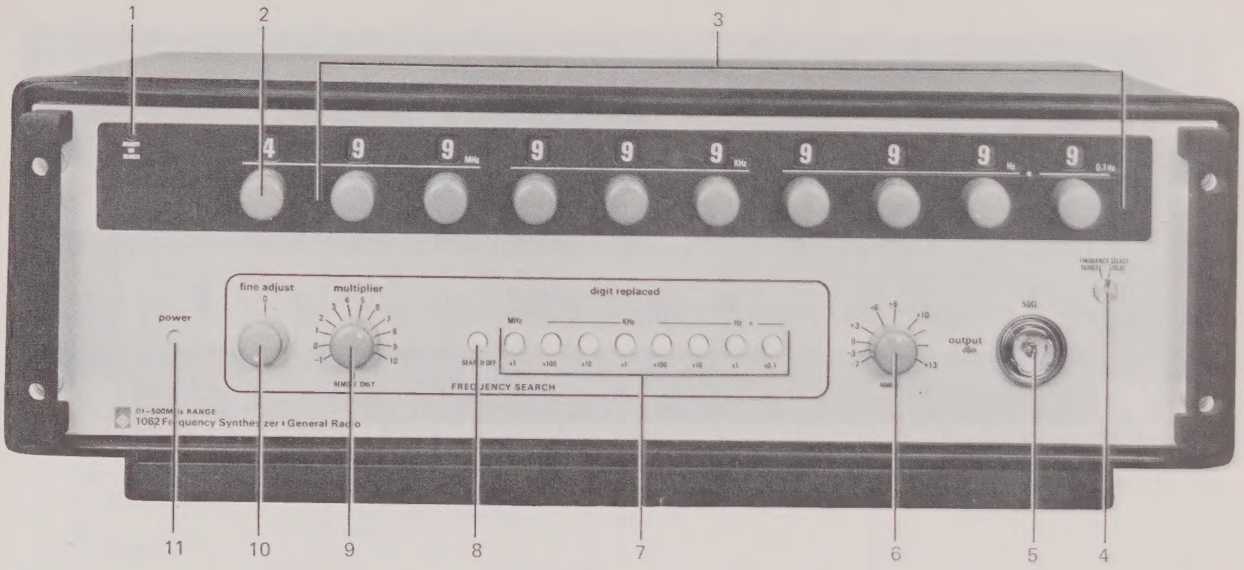

Figure 1-1. Front panel controls, connectors and indicators for synthesizer with option 1.

Table 1-1

FRONT-PANEL CONTROLS, INDICATORS, AND CONNECTORS

Fig 1-1 Item	Name	Description	Function	Remarks
1	REMOTE OR SEARCH NOTE Items 1-10 characterize option-1 instruments.	Red panel lamp	Indicates remote or search operation	Lights when FREQUENCY SELECT control is set to REMOTE or a SEARCH pushbutton is depressed.
2 and 3	——	Frequency knob/dial assemblies. (Item 2) has 5-pos. switch, (item 3) has 10-pos. switches.	(Item 2) provides local control of most-significant digit; (item 3) all other digits.	Not effective in REMOTE mode of operation.
4	FREQUENCY SELECT	Switch, 2 pos., labeled: REMOTE, LOCAL.	Selects local or remote frequency control.	Energizes REMOTE lamp when set to REMOTE.
5	OUTPUT 50 Ω	GR874®, low-loss, quick-connect connector.	External connection for output signal.	May be alternatively mounted on rear panel.
6	OUTPUT dBm	Calibrated rotary potentiometer, panel marked from extreme ccw position: REMOTE, −7, −3, 0, +3, +6, +8, +10, and +13.	Controls and indicates the r-f output into 50 Ω.	REMOTE position transfers control to rear-panel BNC connector (Item 16).
7	Digit Replaced, Hz	Pushbutton switches, panel marked: X.1, X1, X10, X100 Hz; X1, X10, X100 kHz, and X1 MHz.	Replaces step digit indicated by panel marking with continuously adjustable search/sweep capability.	Range of frequency control of selected decade is −1 to +10 times the replaced step digit.
8	SEARCH OFF	Pushbutton switch	Disables the search capability by releasing all digit replaced buttons when depressed.	
9	Multiplier	Calibrated rotary potentiometer. Panel marked: REMOTE ONLY, −1, 0, 1, 2, 3, ... 9, 10.	Controls and indicates the replaced digit.	Multiply the pushbutton-selected digit-replaced value by the setting of this control.
10	Fine Adjust	Rotary potentiometer, continuously adjustable, "0" position indicated by panel marking.	Uncalibrated vernier on above.	Use to obtain the ultimate settability of frequency. Set to 0 for max multiplier accuracy.
11	POWER	White panel lamp	Indicates instrument is on.	Turn-on accomplished when line cord is connected. There is no power switch.

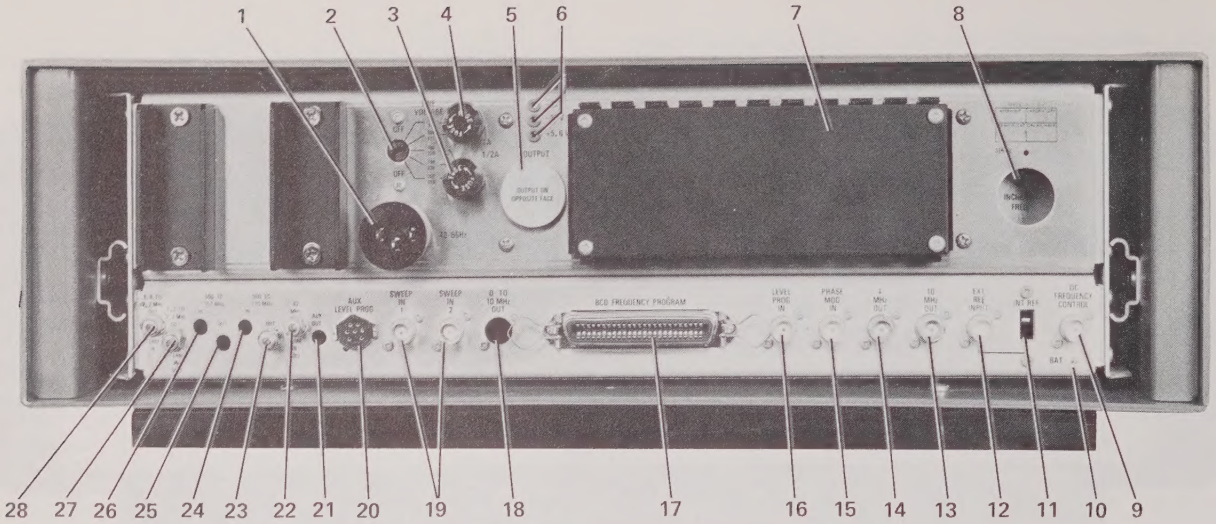

Figure 1-2. Rear apron controls and connectors.

Table 1-2

REAR-PANEL CONTROLS AND CONNECTORS

Fig 1-2 Item	Name	Description	Function	Remarks
1	——	Safety type line-voltage plug, 3-wire (IEC Standard).	Accepts 3-wire ac-line cord, Belden SPH-386 or equivalent.	Use GR Power Cord P/N 4200-9625
2	LINE VOLTAGE	Rotary switch, 7 position	Switches line-voltage connection to one of 5 ranges or off.	Panel labeled: OFF, 90-110, 104-127, 180-220, 194-236, 207-253, and OFF.
3	FUSE/½ A	Extractor-post, fuse holder	Protects instrument on 3 highest line-voltage ranges.	Fuse is type MDL.
4	FUSE/1 A	Extractor post fuse holder	Protects instrument on 2 lowest line-voltage ranges.	Fuse is type MDL.
5	OUTPUT	Removable disc on OP1 units	Used to cover vacant front- or rear-panel OUTPUT connector hole.	
6	——	Pin jacks, 0.80 in. dia.	Three power supply test points	Panel labeled: +18 V, −12 V, and +5.6 V.
7	——	Metal cover	Cover for power transistors and power-supply adjustments.	Remove cover to obtain access to the power transistor or the +18 V, −12 V, and +5.6 V adjustments.
8	——	Screwdriver-type adjustment	Frequency adjustment for reference oscillator.	Option 2B instrument only.
9	DC FREQUENCY CONTROL	BNC jack connector	Input connection for dc control of internal reference oscillator frequency.	+6 to +9 V, internally biased to +8 V. $\Delta F > 5X10^{-6}$, op2A-, $\Delta F > 5X10^{-7}$, op 2B
10	BAT	Pin jack, .08 in. dia.	External battery connection to maintain constant crystal oven temperature in the reference oscillator during power interruption.	15-18 V, 0.2 A max.
11	INT/EXT REF	Slide switch, 2-position.	Permits a choice of internal or external drive.	Disconnects internal reference oscillator when set set to EXT REF INPUT position.
12	EXT REF INPUT	BNC jack	Input connection for external reference oscillator.	A 5- or 10-MHz external standard at 0.13 V to 2.5 V into 50 Ω.
13	10 MHz OUT	BNC jack	Connection for 10-MHz output signal	Derived from reference-oscillator source. Level is 0.5 V ± 20% into 50 Ω.

Table 1-2 (cont)

REAR-PANEL CONTROLS AND CONNECTORS

Fig 1-2 Item	Name	Description	Function	Remarks
14	1 MHz OUT	BNC jack	Connection for 1-MHz output signal	Derived from reference oscillator source. Level is 0.8 V pp into 10 kΩ.
15	PHASE MOD IN	BNC jack	Connection for phase-modulation-input signal.	(see specifications)
16	LEVEL PROGRAM IN	BNC jack	Connection for remote control of output level.	RMS output voltage is 1/4 of positive dc program voltage; accuracy is ±1 dB, level is −7 dBm to +13 dBm into 1 kΩ, less than 100 μs programming response time to within 1 dB of final value above 400 kHz. (See also item 6, front panel.)
17	BCD FREQUENCY PROGRAM	Amphenol, Type 57 connector, 50-pin	Connection for BCD frequency program input signals.	See Figure 2-5.
18	BLANK			
19	SWEEP IN	BNC jacks labeled 1 and 2	Connections for 2 summing inputs for external control of sweep.	Range of control is −1 to +10 times the replaced stepped digit. Sensitivity is 0.5 V/digit with maximum nonlinearity of ± 0.3 digits. Sweep (FM) rate: 0 to 20 kHz; Distortion 6% max. (3% at 5 kHz)
20	AUX LEVEL PROG	A 7-pin jack that mates with Amphenol type 126-195 plug connector	May be specially wired for System applications	
21	BLANK			
22	42 MHz	SMA jack, Terminated in 50 Ω.	Provides output for system applications	These connections may be used as test points to check internal operation in trouble shooting. See detailed block diagram for normal signal levels.
23	500 to 510 MHz OUT	SMA jack, Terminated in 50 Ω.	Provides output for system applications	
24	BLANK			
25	BLANK			CAUTION Outputs require terminations for proper operation of synthesizer*.
26	BLANK			
27	2.3 to 2.2 GHz out	SMA jack, Terminated in 50 Ω.	Provides output for system applications	
28	1.8 to 2.2 GHz out.	SMA jack, Terminated in 50 Ω.	Provides output for system applications	

*Terminate with coaxial 50Ω load in SMA connector series. Use Model 4110-P Mfg. by EMC Technology Corp., 1300 Arch St., Phila., Pa.

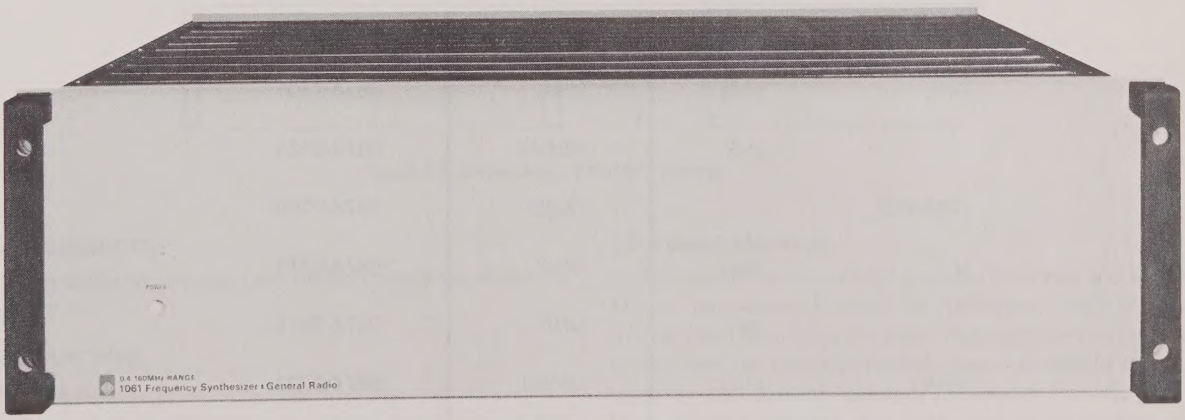

Figure 1-3. Basic synthesizer in rack version equipped for remote control and external drive only. Can include all options except option 1.

1.6.2 Coaxial Adaptors.

As with similar General Radio equipment, the synthesizers use the quick-connect GR874 coaxial connector. However, for the user wishing to mate the instruments with components fitted with coaxial connectors of some other series, it is a simple matter to adapt to that series.

GR874 adaptors to leading commercial and military coaxial series (or to binding posts) are available to convert to the desired type. These adaptors are listed in Table 1-4.

Over-all VSWR of the converted GR874 connector is typically no greater than that of the other-series connector by itself, and leakage at the GR874 junction is typically >120 dB down.

1.6.3 75-Ω Matching Pad.

The Type 874-MP Matching Pad is a two port, minimum loss, resistive network with a typical loss of 5.72 dB. Each end of the pad is fitted with a GR874 locking connector. The principal application is the conversion of the GR874 OUTPUT connector of the synthesizer from a 50-Ω to a 75-Ω impedance.

The frequency range of the pad is dc to 1 GHz and it can be used to 8.5 GHz. The maximum power rating is 1 W continuous.

For more information on a complete line of coaxial adaptors, consult your General Radio catalog.

Table 1-3

ACCESSORIES SUPPLIED

Name	Description	Part Number
Power Cord	7-feet, 3-wire	4200-9625
Coaxial Patch cord	3-feet, Type 874-R22LA	0874-9683
FREQ PROGRAM Connector	50-pin, Amphenol Type 57	Amphenol P/N 57-30500

Table 1-4

GR874 ADAPTORS

TO TYPE		TYPE 874†	GR PART NUMBER
APC-7		QAP7L	0874-9791
BNC	plug	QBJL	0874-9701
	jack	QBPAL	0874-9801
GR900®		Q900L	0874-9709
N	plug	QNJL	0874-9711
	jack	QNPL	0874-9811
SMA	plug	QMMJ	0874-9723
	jack	QMMP	0874-9823

† Locking GR874 Connector. Example: To connect Type 874 to a type-N jack, order Type 874-QNPL

Installation—Section 2

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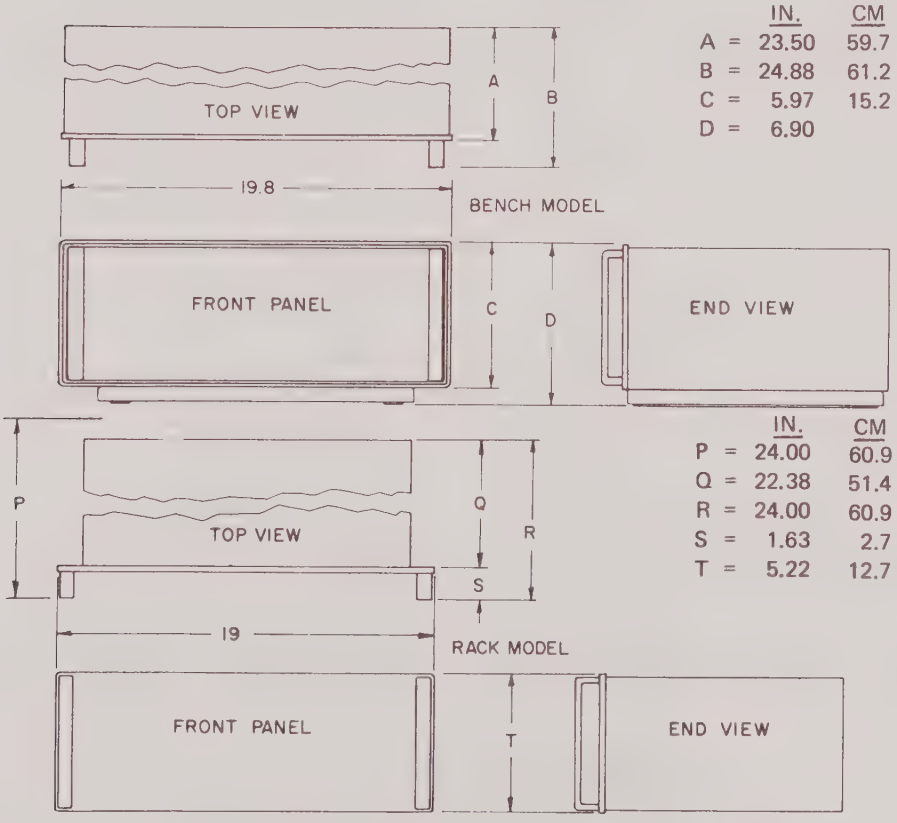


	IN.	CM
A =	23.50	59.7
B =	24.88	61.2
C =	5.97	15.2
D =	6.90	

	IN.	CM
P =	24.00	60.9
Q =	22.38	51.4
R =	24.00	60.9
S =	1.63	2.7
T =	5.22	12.7

Figure 2-1. Dimensions of the Synthesizer.

2.1 DIMENSIONS.

Dimensions of the rack and bench models are shown in Figure 2-1.

2.2 MOUNTING.

2.2.1 General.

The unit is available in two models, bench mount and relay-rack mount, either of which can be converted to the other by the installation of a simple conversion set.

2.2.2 Bench Mounting.

The bench-mount cabinet is made of formed and welded 1/8-in. aluminum finished in baked-on, medium gray crackle paint and has a tilt base. The instrument is retained in the case by four front-panel screws accessible through holes in the carrying handles. To remove the instrument from its case, remove the four front-panel screws and withdraw the instrument. Slide blocks on the instrument engage tracks in the case to guide insertion and withdrawal.

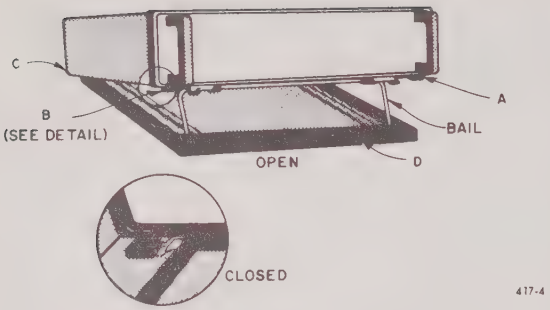


Figure 2-2. The bail can be used to tilt the instrument, providing a better view of the front-panel indicators.

To insert the instrument into the case, straddle the tracks with the rear guide blocks and push all the way into the case. Secure the four front-panel screws.

WARNING

When tilting the instrument or removing the tilt, do not allow your fingers to come between the cabinet and its base.

2.2.3 Tilting.

The bench models of the synthesizer are delivered completely assembled in a metal cabinet, ready for bench use. A convenient bail, located along the bottom front edge of the instrument, can be pulled down to raise the front and provide a better view of the front-panel indicators (see Figure 2-2). To tilt the instrument, proceed as follows:

a. Place the right thumb on the right-hand release toggle (A) and the left thumb on the left-hand release toggle (B) under the front corners of the instrument.

b. Push both release toggles toward the rear as far as they will go.

c. Using the rear of the base (C) as a pivot, lift the front of the instrument, permitting the bail to drop down on the base.

d. With one hand, hold the instrument in the tilted position; with the other, pull the bail forward as far as it will go and carefully lower the instrument. The bail is now locked in place and the instrument will remain in the tilted position.

Reverse this procedure to eliminate the tilt. Be sure the toggles are pushed back, toward the rear of the instrument. Then lower the front carefully onto the base. Lock the base to the bottom of the instrument by sliding the toggles (A and B) forward.

2.2.4 Cabinet Removal.

To remove a bench-model instrument from its cabinet:

Remove the four panel screws (A, Figure 2-3), P/N 7270-6310, two on each side of the front panel. These are No. 10-32, 9/16-in. screws, with nylon washers. To loosen them, insert a Phillips-head screwdriver through the holes in the handles, shown in the figure. Then pull the instrument forward, out of the cabinet.

2.2.5 Conversion to Rack Mounting.

The following procedure is used to convert a bench model to a rack-mounted model.

a. Order rack-cabinet assembly (P/N 4174-3743) and a hardware set (P/N 4174-2007).

b. Disconnect any external cables, remove the front-panel screws and withdraw the instrument from the case.

c. Install the rack-cabinet in the relay rack and insert the instrument.

2.2.6 Relay-Rack Installation.

To install a rack-model instrument in an EIA standard RS-310 19-in. relay rack, with universal mounting-hole spacing, proceed as follows:

a. Remove 4 dress-panel screws (A) and slide the instrument out of the cabinet, discard the nuts and washers. When free motion along the tracks is stopped, tilt the front

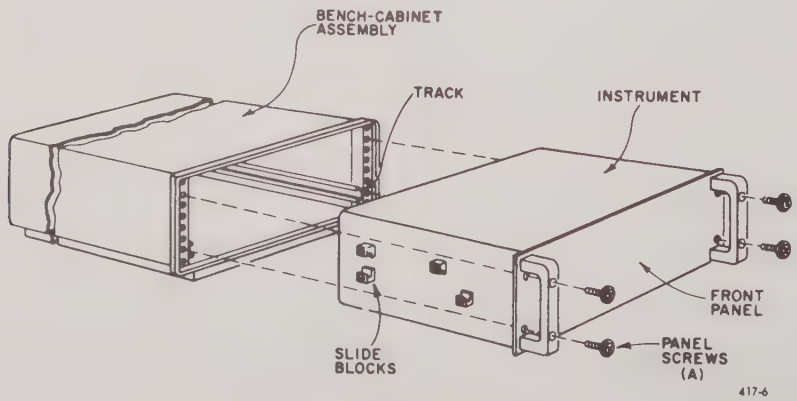


Figure 2-3. Bench cabinet assembly.

of the instrument up slightly. Continue withdrawal, past the stops, pulling the instrument horizontally until it is free.

b. Insert the rack cabinet wherever desired in the rack — be sure it's level — and fasten it with 4 screws (C) to the front rails.

c. If the rack contains a rear support rail, use brackets (D) to support the cabinet with the rear rails; open-slotted screw holes allow positioning.

d. Use the set of slots in the sides of the cabinet that allow alignment of the open-slotted holes in the brackets with threaded holes in the rail. The long flange should extend to the rear.

e. Insert screws (E) from inside the cabinet, through the slotted holes and drive them into the holes in the long flange of the bracket. Each side takes 2.

NOTE

Start the screws in the appropriate holes off the rack, to make the threading easier.

f. Pass screws (B) through brackets and screw 2 into each rear rail. (Details may be varied to suit particular situations.)

g. To install the instrument, first set its rear edge in the cabinet front opening. Slide the instrument back, making sure that the rear and the upper front slide blocks engage the tracks. (Stops prevent further insertion.)

h. Pull the instrument forward *with* the tracks, keeping a hand on each side (fingers underneath). Slide the instrument back about ½ in. along both tracks, past the stops, by pressing down on the tracks (with thumbs) while tilting the front of the instrument up slightly.

i. Push the instrument back into the rack, checking for smooth operation of the tracks and slide blocks.

NOTE

The instrument is now readily accessible for behind-the-panel adjustments. It slides in and out freely on extending tracks.

j. Fasten the instrument in place, using 4 dress-panel screws (A). (Insert the screwdriver through holes in the handles.)

2.2.7 Conversion to Bench Mounting.

a. Order a 4173-4014 bench cabinet assembly (includes hardware set).

b. Disconnect any cables from the instrument, remove the front panel screws and withdraw the instrument from the rack cabinet.

c. Insert the instrument into the bench cabinet, straddling the tracks with the slide blocks. Secure the instrument with the four front-panel screws.

2.3 REMOTE PROGRAMMING CONNECTIONS.

2.3.1 General.

Both the master and slave versions of the unit can be programmed for remote control of output frequency and output level. Table 2-1 lists the three variations of the remote control mode.

Table 2-1

REMOTE-CONTROL-MODE VARIATIONS

OUTPUT	
Frequency	**Voltage**
Local	Remote
Remote	Local
Remote	Remote

2.3.2 BCD FREQUENCY PROGRAM Socket.

Frequency programming connections are made to the rear-panel BCD FREQUENCY PROGRAM socket (Figure 1-2). This 50-pin Amphenol Type 57 socket (GR P/N 4230-4049) mates with a 50-pin Amphenol Type 57 plug (Amphenol P/N 57-30500).

RACK HARDWARE SET 4174-2007

Ref.	*Quantity*	*Description*
D	2	L brackets with open-slotted holes.
E	4	Screws, 8-32, 3/16 in., thread forming.
C, B	8	Screws, 10-32, 1/2-in., thread forming.

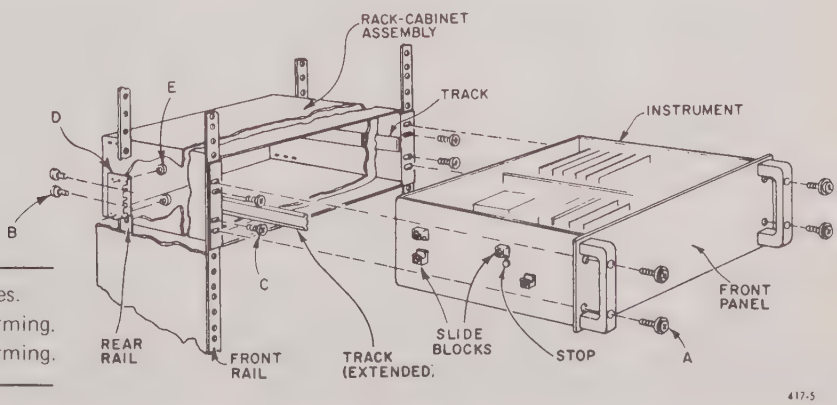


Figure 2-4. Method of mounting the relay-rack model.

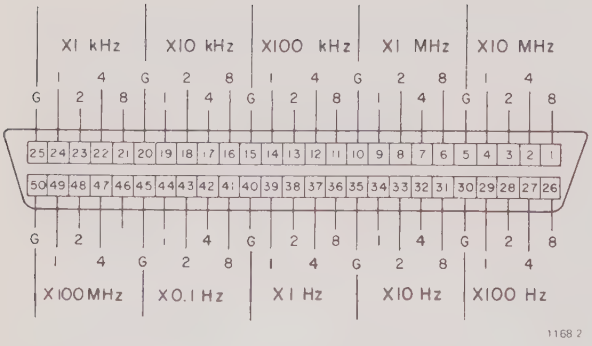


Figure 2-5. BCD FREQUENCY PROGRAM socket connections as viewed from the rear of the instrument.

The information provided in Figure 2-5 can be used to assemble a cable through which the synthesizer can be programmed. Connections can be made with any electrical wire or cable but it is recommended that 4-wire shielded cable be used — a separate one for each frequency decade. A separate ground terminal is provided adjacent to each group of four terminals, which can be used for connecting the shield of each cable. Cable resistance is completely negligible for lengths up to 100 ft.

The color-coding of the recommended cable-conductors should match the 1-2-4-8 code (brown, red, yellow, and grey) for easy identification within a cable. It is suggested that the individual cables be marked with color bands at each end to identify the rank of the decade it connects.

A strain relief should be used under the plug clamp to relieve the cable of strain and to avoid pinching the wires when the clamp is tightened. A simple strain relief can be made by wrapping electrical tape around the cable assembly and tightening the clamp around the tape.

All external frequency selection is by 1-2-4-8 BCD control with external program connections provided by a rear-panel multiple contact plug. Logic levels are +5 V for logic "0" and +0.5 V or less for logic "1". An internal 2-kΩ pull-up resistor is provided to keep all program lines at logic "0" unless the external circuit is completed to ground; 3 mA or less will program a logic 1. These levels are compatible with external DTL or TTL integrated circuit gates or inverters.

The switching speed is 50 μs worst case, for the frequency to be within 500 Hz. See specifications.

2.3.3 LEVEL PROGRAM Connector.

The output level is set by an external dc signal applied to the rear-panel LEVEL PROG IN connector of 4x the desired rms output voltage. Programming response time is < 100 μs to within ±1 dB of the desired level above 400 kHz; 300 μs 100 to 400 kHz; 3 ms, 10 to 100 kHz. The input impedance is 1 kΩ. The synthesizer output into 50 Ω, from a 50-Ω source impedance, is −7 to +13 dBm (or 0.10 to 1.0 V).

2.4 POWER-LINE CONNECTION.

The power-transformer primary windings can be switched, by means of the five-position switch (Figure 1-2) on the rear panel, to accept a line voltages of 90-110, 104-127, 180-220, 194-236, or 207-253 V. Operation at line frequencies up to 440 Hz, with lower line voltage limits increased by 5%, or down to 45 Hz with upper limits reduced by 5% is satisfactory.

Connect the 3-wire power cable (P/N 4200-9625) to the line and to the 3-terminal male connector (Figure 1-2) on the rear panel. A 1-A fuse is used at the 2 low voltages. A 0.5-A fuse is used at the 3 higher voltages. Power consumption is approximately 70 W.

2.5 LINE-VOLTAGE REGULATION.

The accuracy of measurements accomplished with precision electronic test equipment operated from ac line sources can often be seriously degraded by fluctuations in primary input power. Line-voltage variations of ±15% are commonly encountered, even in laboratory environments. Although most modern electronic instruments incorporate some degree of regulation, possible power-source problems should be considered for every instrumentation setup. The use of line-voltage regulators between power lines and the test equipment is recommended as the only sure way to rule out the effects on measurement data of variations in line voltage.

The General Radio Type 1591 Variac® Automatic Voltage Regulator is a compact and inexpensive equipment capable of holding ac line voltage within 0.2% accuracy for input ranges of ±13%. It will assure, for example, that an instrument rated for 100-125 (or 200-250) V can be operated reliably in spite of varying input voltages in the range 85-135 (or 170-270) V. The 1 kVA capacity of the 1591 will handle a rack full of solid-state instrumentation with no distortion of the input waveform. This rugged electromechanical regulator comes in bench or rack-mount versions, each with sockets for standard 2- or 3-wire instrument power cords.

2.6 ENVIRONMENTAL CONDITIONS.

The instrument is designed to operate in a relay rack over the ambient air-temperature range, inside the rack, of 0 to 50°C. When mounted in a bench cabinet the outside air-temperature range is 0 to 50°C. The nonoperating

storage-temperature range is −40°C to +75°C. Permissible maximum relative humidity of the ambient is 95% with the instrument operating. The instrument will withstand normal shock and vibration encountered in nonmobile applications. With more severe vibration conditions, operation may be satisfactory but the General Radio Company should be consulted for recommendations.

2.7 EXTERNAL CONNECTORS.

2.7.1 External Battery Connector.

A pin jack connector, marked BAT, on the rear apron permits a "keep alive" battery (*not supplied*) to be connected to the crystal oven. Any 15 V to 18 V nickel cadmium battery is sufficient.

If used, the battery will maintain the crystal oven temperature in case of a power interruption. Internal diodes isolate the battery during normal operation and provide automatic switchover if ac power is removed.

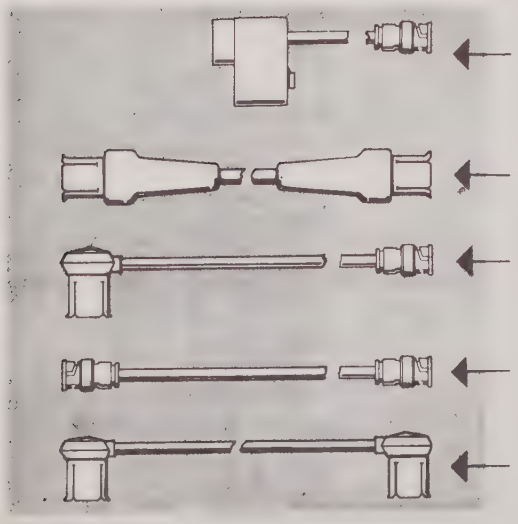
2.7.2 Level Program (Amplitude Modulation).

In addition to the d-c level programming described in para. 2.3.3, amplitude modulation can be applied at this connector, along with a suitable d-c voltage to establish the carrier level. For example, if an a-c source calibrated to drive 600 ohms is used say, for modulating frequencies of 50 Hz and higher, it may be connected to this connector with a 10-μF series capacitor and a low-output-resistance d-c source connected to the same point with a 600-ohm series resistor. If the d-c source is then set for +2 V and the a-c source set to deliver 2 x 0.707 x 0.9 = 1.27 V, rms, an output of 7 dBm will be obtained with 90% amplitude modulation. Any other combination of modulating and d-c voltages can be used, as long as the output level on modulation peaks does not exceed 13 dBm and the modulation percentage is kept under those in the specifications for the various frequency ranges. Modulation rates down to d-c can be used but this requires a resistive (or operational amplifier) external adder, instead of the simple RC combining filter described above.

2.7.3 Sweep In.

Two rear panel sweep input connections are provided. Up to ±5 volt signals may be simultaneously applied to these inputs with or without the option 1 panel sweep control on its remote only position. The result of all inputs is summed to produce frequency control of the selected digit. If the range of control is exceeded, internal limiting prevents the frequency from being changed beyond allowable limits. As a result of the summing feature a small amount of fm can be superimposed on a steady dc offset provided by the panel control or a dc input signal; or two f-m rates can be simulaneously applied. The sensitivity to either rear panel input is a frequency charge equal to one digit step for each 0.5 V increment applied, zero digit frequency occuring when the sum of all inputs is 0 V. The input impedance at each input is 30 kΩ.

Table 2-2
AVAILABLE INTERCONNECTION ACCESSORIES



776-A	Patch cord, shielded double plug to BNC plug, 36" long	0776-9701
874-R22A	Coaxial patch cord GR874 to GR874, 36" long	0874-9682
776-B	Patch cord, GR874 (right-angle) to BNC plug, 36" long	0776-9702
776-C	Patch cord, BNC plug to BNC plug, 36" long	0776-9703
776-D	GR874 to GR874, both right-angle, 36" long	0776-9704

274-13XA

2.7.4 Auxiliary Level Program Connections.

A 7-pin connector on the rear apron of the instrument may be wired to accept level-program inputs for special applications. Existing wiring provides an external test point to check the operation of the ALC circuitry.

The apron connector accepts the Amphenol type 126-195 plug, wired as shown in Figure 2-6.

2.8 UNPACKING AND INSPECTION

If the shipping carton is damaged, ask that the carrier's agent be present when the instrument is unpacked. Inspect the instrument for damage (scratches, dents, broken knobs, etc.) If the instrument is damaged or fails to meet specifications (Operational Checks, para 3.4), notify the carrier and the nearest General Radio field office (see list at back of this manual). Retain the shipping carton and the padding material for the carrier's inspection.

2.9 STORAGE AND SHIPMENT

2.9.1 Packaging.,

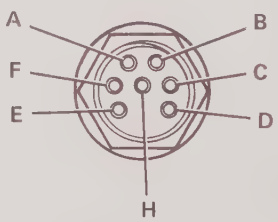
To protect valuable electronic equipment during storage or shipment, always use the best packaging methods available. Your General Radio field office can provide packing material such as that used for original factory packaging. Contract packaging companies in many cities can provide dependable custom packaging on short notice. Here are two recommended packaging methods:

Rubberized Hair. Cover painted surfaces of instrument with protective wrapping paper. Pack instrument securely in strong corrugated container (350 lb/sq in. bursting test) with 2-in rubberized hair pads, placed along all surfaces of the instrument. Insert fillers between pads and container to ensure a snug fit. Mark the box "Delicate Instrument" and seal with strong tape or metal bands.

Excelsior. Cover painted surfaces of instrument with protective wrapping paper. Pack instrument in strong corrugated container (350 lb/sq in. bursting test) with a layer of excelsior about 6 in. thick, packed firmly against all surfaces of the instrument. Mark the box "Delicate Instrument" and seal with strong tape or metal bands.

2.9.2 Special Reshipment Instructions.

There are no special procedures or facilities required for reshipment of the instrument.



Pin	Function	Remarks
A	Level Monitor-Signal	Output-indicator or test point
B	Level Monitor — Shield	Chassis Ground
C	ALC Output — Shield	Chassis Ground
D	Level Program — Shield	Chassis Ground
E	No connection	—
F	ALC Output — Signal	Test point
H	Level Program — Signal	0 to +4 Vdc (0.25 Vrf/Vdc)

Figure 2-6. AUX LEVEL PROGRAM socket connections as viewed from the rear of the instrument.

Operation—Section 3

3.1 PRELIMINARY CHECKS 3-1
3.2 INSTRUMENT TURN-ON 3-1
3.3 INSTRUMENT WARM-UP 3-1
3.4 OPERATIONAL CHECKS 3-1
3.5 MODES OF OPERATION 3-2

CAUTION

Do not connect the power cord until the line-voltage switch has been properly set.

3.1 PRELIMINARY CHECKS

Refer to the previous section for a list of the connectors and for tabulation of their functional descriptions. The recommended initial operating procedure follows:

a. Check that the rear-panel line-voltage switch is positioned according to the available power-line voltage. Use the tip of a small screwdriver to turn the switch cw or ccw. The line-voltage frequency must be in the range of 48-66 Hz (except for limited voltage range).

b. Connect the power plug (rear panel) to a suitable power line, using the power cord supplied. The instrument is now on and the front-panel POWER lamp should glow — there is no power switch.

3.2 INSTRUMENT TURN-ON

Because a crystal oven should operate continuously, an on-off power switch is not provided with the synthesizer. Instrument turn-on is accomplished by connecting the a-c line to the rear-panel power connector.

The OP2B synthesizer uses a built-in precision quartz-crystal oscillator for its internal driving source. This crystal is housed in a temperature controlled oven, for optimum oscillator stability, and has a relatively long warm-up interval if the power is interrupted. A rear-panel connector is provided for connecting an external battery to the crystal oven. This connection may be desirable in case of a power failure or if for some reason the unit has to be turned off.

3.3 INSTRUMENT WARM-UP

Since the unit is all solid-state, except for the indicator lamps, no warm-up time is required to generate output. However, in applications where the synthesizer is phase-locked to an already operating external standard, it is necessary to allow complete equipment warm-up to a steady-state condition, if the ultimate in stability is required.

NOTE

Very small frequency errors, due to phase drifts of tuned circuits in the synthesizer, can be important in some demanding applications.

For extremely precise work, a warm-up period of 2 hours or more is recommended for the precision oscillator. When feasible, round-the-clock operation is desirable if high precision is apt to be required on short notice. Instruments without OP2A or OP2B require an external drive source of 10 or 5 MHz, with a 0.13 to 2.5 V level,

3.4 OPERATIONAL CHECKS

NOTE

All operational checks given below assume a remote-only version of the synthesizer or a manual control option instrument set for remote control. It is probably obvious the checks can be even more readily performed if a manual-controlled instrument is to be checked.

3.4.1 General.

These procedures can be used for incoming inspection, operator familiarization, or as a periodic operation check.

3.4.2 Proper Frequency Generation.

For a quick check of proper frequency generation, use the following procedure (refer also to para. 5.5):

a. Connect the OUTPUT connection to INPUT A of the 1191/Z Counter. Use a GR 874-QBPAL adaptor and a 776-C patch cord

b. Ground the various pins of the frequency program plug so as to set the output frequency between 10 kHz and 500 MHz.

c. Observe the counter visual register. It should display the same frequency set by the frequency program lines.

A convenient frequency-programming assembly can be constructed, using the 378-series DIGISWITCH. It provides 8-4-2-1 BCD contact closures, for each station that can be wired, to program up to 10 frequency decades, via a rear-panel connector (Figure 2-5). A DPST switch can be added to all decades through 1 MHz/step, to ground the 8 and 2 lines, to enable sweep operation. An interlocked pushbutton switch assembly is recommended to prevent enabling the sweep on more than 1 decade at a time.

3.4.3 Sweep Check (Figure 2-5)

A center frequency of 10 MHz and a sweep width of 20 kHz are used as an example for this check. Other sweep-width combinations will do as well. A manual sweep, rather than a repetitive sweep voltage, is used so that the output frequency can be read on the counter.

a. Set the frequency program lines for a center frequency of 10 MHz (ground pin No. 4).

b. Program a 10 at the 10-kHz decade (ground pins No. 16 and No. 18).

c. Connect the 1191-Z Counter to the OUTPUT connector.

d. Apply a variable dc voltage from 0 V to +1 V at SWEEP IN 1 and observe the output frequency. The frequency should change from 10.000 to 10.020 MHz. Repeat the measurement using the SWEEP IN 2 connection.

The above procedure can be used for any desired combination of sweep width control settings, as long as the counter resolution is sufficient to read both extremes of the sweep frequency.

3.4.4 OUTPUT Voltage Level

a. Set the synthesizer to any frequency within its output-frequency range.

b. Connect the GR 1806 Electronic Voltmeter, by its -P1 Probe and probe tee terminated in a GR 874-W50BL, 50-Ω termination to the synthesizer OUTPUT connector.*

c. Apply a d-c voltage to the synthesizer LEVEL PROG IN connector for maximum output; +4.00 Vdc, +13 dBm = 1.0 V, rms,

d. Observe the 1806 indication, which should be within 6% of ¼ the applied dc voltage, or within 0.6 dBm of the equivalent power on the hp431.

3.4.5 Frequency Programming

A switch or solid-state closure to ground will change the program lines from the "0" state to the "1" state. The frequency programming circuits can be functionally checked with a counter and a test lead that has a probe on one end and a clip on the other.

For example, adjust the controls for remote frequency operation and connect the 1191/Z counter to the output connector. Pick a frequency within the frequency range of the synthesizer and refer to Figure 2-5 for its corresponding terminal number. For this example we will use 10 MHz. Clip one end of the test lead to the chassis and touch the probe to terminal 4 of the BCD FREQUENCY PROGRAM socket. Observe the 10-MHz reading on the visual register of the counter. Note that the count disappears as soon as the short to ground is removed. This happens because all lines maintain logic 0 unless a closure to ground is made.

3.4.6 Manual Operation.

With manual-operation (OP1) instruments, a series of dials permits frequency setting with an in-line display of the selected steps. Also, a decade to be searched can be selected by pushbutton and a calibrated panel control permits continuous variation of the frequency. An uncalibrated fine control permits setting the frequency to 1/100th of a step.

3.5 MODES OF OPERATION.

3.5.1 General.

In addition to using the master oscillator as the internal precision frequency source, it can be replaced by an external frequency standard. The sweep capability can be switched on or off and over-all instrument operation can be locally (manually) or remotely controlled.

3.5.2 Master Oscillator.

Internal Drive. In this mode of operation, the internal master oscillator is used as the synthesizer driving source and determines the output frequency stability. To use the oscillator in this manner, set the rear-panel switch to the INT REF position (white marker up).

External Drive. Setting the rear panel slide switch down to EXT REF INPUT disables the internal oscillator and connects the rear-panel connector directly to an amplifier, in the synthesizer. This method of operation is useful in case of internal oscillator failure or power interruptions that impair oscillator stability. With no internal oscillator, this is the only means of operation.

Make the connection and set the control as follows the external-drive operation:

Slide Switch	EXT REF INPUT
EXT REF INPUT . . .	Connect a 5-MHz or 10-MHz Precision Source**

3.5.3 Emergency Operation.

There are no emergency operation procedures applicable.

*Use hp431 with hp478A above 50 MHz.

**The external drive level must be 0.13 V to 2.5 V into 50 Ω at rear panel BNC Connector.

Theory—Section 4

4.1 GENERAL 4-1
4.2 SYNTHESIZING PROCESS 4-1
4.3 DETAILED CIRCUIT ANALYSIS 4-2

4.1 GENERAL.

This section contains a functional description to the functional-diagram level of Figure 6-3, and a more detailed circuit analysis. For a detailed block diagram, with each block representing a physical part of the instrument, refer to Figures 6-4 and 6-5.

Para. 4.2 is a functional-diagram-level description of circuit operation. The more detailed circuit analysis (para. 4.3) has a separate paragraph for each section and uses both sectional and functional names to refer to a particular section. Included in each paragraph title is a reference to the schematic for that section.

4.2 SYNTHESIZING PROCESS.

The synthesizer derives its output frequency from a single reference source by means of arithmetic operations on frequency (addition, subtraction, multiplication and division). A separate phase-locked oscillator is used for each digit of resolution, up to 10-MHz steps. A drift-cancelled oscillator is used for 100-MHz step selection.

In the decade phase-locked oscillators, for 1-MHz steps and smaller, search/sweep capability is provided. This mode is enabled by programming 8 + 2 on the BCD control input, which disables the phase-lock and connects the external sweep input to the varactor control of that particular oscillator. The sweep input is processed by a common-drive circuit, which compensates for the identical, though nonlinear, varactor-control characteristics of the various digit oscillators.

The iterative circuit shown in the lower right corner of the functional diagram is used in all lower decades for the resolution options.

The synthesizing process is controlled by a common-master oscillator, or by an external source of either 5 or 10 MHz. Two master oscillators are available, a moderate stability 5-MHz nontemperature-controlled crystal oscillator, OP2A, or a high-stability 10-MHz precision-crystal oscillator in a proportionally controlled oven, OP2B.

Either oscillator can be controlled over a limited frequency range by an external dc voltage for tracking, locking or offsetting the frequency by external circuitry. No internal locking circuits are provided. A rear-panel switch permits selection of the internal master oscillator, if installed, or an external reference source applied at a rear-panel connector.

The reference signal from the internal master oscillator or the external reference is doubled in frequency (if 5 MHz), limited, and passed through a 1-kHz bandwidth monolithic crystal filter, to provide a clean 10-MHz reference for the synthesizer. Frequency dividers furnish 5 MHz to the first mixer in the synthesizing process and the 1 MHz phase-lock reference for all digit-oscillator steps of 1 MHz and smaller.

The 10-MHz signal is converted into a short pulse to generate all other fixed reference frequencies. This pulse is used directly as the phase-lock reference for the 10-MHz digit steps, and its 70-MHz component is used to drive a frequency divider-multiplier combination to produce a 42-MHz reference for the earlier synthesis circuits. The same 70-MHz signal is multiplied by 6, after passing through the phase modulator, to produce the 420-MHz reference for the next-to-last up-conversion in the combining process, for 1 MHz and smaller digit steps.

In the 10-kHz per-step and lower decades, the synthesis process consists of adding 5 to 5.1 MHz to 42 MHz to produce 47 to 47.1 MHz. Then, a selected 100-kHz step of a 3 to 3.9 MHz phase-locked oscillator is added to produce a frequency in the 50- to 51-MHz range, which is divided by 10 to produce an output in the 5- to 5.1-MHz range. This process is repeated to produce a series of successive decades of frequency control for optional added resolution. The first mixer in the chain is supplied with a 5-MHz fixed frequency to start the process. When search/sweep is enabled for a particular decade, its frequency is continuously adjustable by an external control

voltage, instead of being precisely detented by the phase-lock loop.

The 100-kHz-per-step-decade signal processing is similar to that described for the 10-kHz decade, except that the 50- to 51-MHz output from the second mixer is not divided by 10; consequently the steps generated by the digit oscillator for this decade are the same as those provided by the oscillator itself, or 100 kHz.

The 1-MHz-per-step decade signal processing is the same as that described for the 100-kHz decade but all frequencies involved are 10 times higher, including the 1-MHz steps in the 30- to 39-MHz range from the digit oscillator.

The 500- to 510-MHz output contains all digit information of the 1 MHz and smaller steps in the synthesizer.

The 10-MHz steps are obtained from a 300-to-210 MHz phase-locked digit oscillator. The zero step programs 300 MHz and each successive input step produces a 10-MHz lower frequency, down to 210 MHz.

The 100-MHz steps are produced by a drift-cancelled varactor-tuned microwave oscillator, programmed in 100-MHz (nominal) steps from approximately 1.8 to 2.2 GHz. The output from this oscillator is added to or subtracted from a 100- or 200-MHz reference source directly related to the 10-MHz synthesizer reference (10th and 20th harmonic), or used directly to produce a frequency of about 2 GHz. This 2-GHz frequency is offset from the 1.8- to 2.2-GHz microwave-oscillator frequency by exactly −200, −100, 0, +100 and +200 MHz, for the successive 100-MHz programmed steps.

The step output of the 300- to 210-MHz oscillator is added to the above 2-GHz signal frequency to produce a 2.3 to 2.2 MHz (nominal) output, with 10-MHz step information. The 500- to 510-MHz signal, with 1-MHz and lower step information, is subtracted from the 2.3- to 2.2-MHz signal to produce a 1.8- to 1.7-GHz signal, with digit information of 10-MHz and smaller steps. It also contains information of the actual plus or minus deviation of the 1.8- to 2.2-GHz frequency of the 100-MHz-step-microwave oscillator from its nominal step frequencies.

The .01 to 500-MHz output is produced by subtracting the 1.8- to 1.7-GHz frequency from the 1.8- to 2.2-GHz frequency. This cancels any errors, due to small offsets in the 1.8- to 2.2-GHz frequency, and combines the 100-MHz digit steps with those of 10 MHz and smaller, to provide the programmed output frequency.

The low-frequency limit of .01 MHz is set by frequency-response limitations of the switched amplitude leveling-loop and practical a-c coupling capacitors in the output amplifier. The actual high-frequency limit for step programming is somewhat determined by the resolution option, being 499.99 MHz for the minimum 10-kHz option.

4.3 DETAILED CIRCUIT ANALYSIS.

4.3.1 Panel Circuit. (Figure 6-6).

The front panel on remote-only options carries only a pilot light to indicate that line power is being supplied to the instrument. Figure 6-6 is a schematic showin all the wiring and controls for a local-control front panel (OP1), as well as the wiring to the related rear-panel connectors, a useful reference for remote-only versions as well.

In the remote-only option, the rear-panel BCD FREQUENCY PROGRAM connector is wired directly to the various digit oscillators. In the local-control options, the rear wafers of all the panel switches are ganged to a single REMOTE/LOCAL control. The 4 control wires for each digit pass through these rear wafers to either the rear-panel connector on REMOTE or the front wafers driven by the front-panel controls, on LOCAL. When the selector switch is in the REMOTE position, a contact closure to a red warning light labeled REMOTE or SEARCH is made, showing that the frequency displayed on the dials is not necessarily that being generated by the synthesizers.

When that selector switch is on LOCAL, the control is by front-panel switches. The switches, except for the most significant (100-MHz step), have no stops, are settable through 10 positions, and provide 8-4-2-1 BCD output corresponding to the decimally displayed numerals on the associated dials. The most-significant-digit selecting switch has 5 positions, 0 through 4 and provides the 4-2-1 binary coded control for 100 MHz steps.

On remote-only-option instruments, or local-control instruments set for REMOTE, the frequency of the 1-MHz and lower decades can be continuously varied by a d-c voltage applied at one or both of the rear-panel SWEEP-IN connectors. This mode is enabled by programming 8 + 2 on the BCD control wires to the decade to be controlled.

In local-control-option instruments, a series of panel pushbuttons labeled OFF, X1 MHz, X100 kHz, X10 kHz, X1 kHz, X100 Hz, X10 Hz, X1 Hx and X0.1 Hz, permit this selection to be made with the frequency control on LOCAL. When any of these buttons, other than OFF, are depressed the red REMOTE/SEARCH panel warning light is illuminated to show that the digital frequency displayed is not necessarily that being generated by the synthesizer. A continuously adjustable MULTIPLIER on the panel, calibrated from −1 to +10 (plus a FINE ADJUSTMENT) is also provided. These controls can be used in a summing fashion, with control voltages applied at the rear inputs, or their effect eliminated by turning the MULTIPLIER to the REMOTE ONLY position.

In instruments with less than full resolution, the ineffective frequency-control knobs and the ineffective frequency-search pushbuttons are disabled by mechanical locks. If additional resolution is installed at a later data, the appropriate locks can be readily removed.

In remote-only options, the OUTPUT level is controlled by a d-c voltage applied at the rear LEVEL PROG IN connector. In local-control options the OUTPUT level can be set by a panel control calibrated from −7 to +13 dBm, or this control can be set to its REMOTE position for external control as above.

The OUTPUT connector is arranged to be mounted on the rear panel of remote-only instruments or on either the front or rear panels of local-control options; a panel filler plug fills the vacant position.

4.3.2 3-MHz Digit Oscillator (Figures 6-7 and 6-8)

Sections EU and EV are identical, except that EU provides the 10-kHz steps and EV the 100-kHz steps in the instrument. The plug-in etched-circuit board is the 1169-4044 Digit Oscillator Board (ED). A sweep-enable circuit, 1169-4024 board (SSE), is part of the enclosure base assembly.

The ED board produces a 3- to 3.9-MHz output in 100-kHz steps. The actual frequency of the oscillator on this board is 30 to 39 MHz, which is phase locked in 1-MHz steps to the 1-MHz reference input. The output from the oscillator splits into two paths. One path goes through a loop buffer to a diode sampling gate feeding a d-c amplifier, with an appropriate lead-lag filter, to form the phase-lock loop back to the dual varactor diodes. The other path goes through a divider buffer, divide-by-10 frequency divider and low-pass filter to the output on terminal 27.

The 1-MHz reference input on terminal 3 is processed by a temperature compensated current-switch limiter and pulse-forming circuit that produces a well-defined triangular sampling pulse. The pulse duration is chosen to minimize response to noise components outside the required frequency range of the lock loop.

Oscillator 10-step frequency selection is derived from the 8-4-2-1 binary-coded-decimal input by means of an intergrated circuit decoder, U3, following an intergrated circuit inverter, U2. Each of the 10 outputs of the decoder selects a different resistor in a precision voltage divider, at the input to the oscillator varactor diodes. This programs the oscillator nominally to within 40 kHz (4 kHz at the output terminal) for each frequency step.

The d-c voltage supplied to the voltage divider is controlled over a limited range by the phase error between the sampling pulse and the oscillator voltage, which causes the frequency to be pulled in and locked to the selected 30 to 39th multiple of the reference. The range of control voltage available is chosen to maintain lock over as wide a frequency error range as possible without the possibility of lock to an incorrect multiple. This provides the maximum correction for oscillator drift and tracking errors.

An inherent characteristic of the varactor diodes is their nonlinear frequency-control characteristic for the range required. A feature of the control system used is that it compensates for this characteristic with the switched voltage divider, so that the lock-loop gain is kept very nearly constant for all frequency steps, permitting an optimum trade-off between switching speed and stability margin.

There are only 4 set-up adjustments on the oscillator and lock circuits for the 10 frequency steps. The varactor control characteristics, though quite nonlinear, are very repeatable between assemblies. This permits the use of the precision resistor network in the programmer, with only minor trimming adjustments on the various board assemblies to bring the characteristics within satisfactory agreement. The major temperature characteristic of the varactors is compensated by a silicon diode, CR4, in series with the applied bias. C8 and C9 are negative-temperature-coefficient capacitors that correct for the remaining temperature characteristics of the oscillator.

The oscillator adjustment C11 permits setting the ratio of maximum-to-minimum frequency, and with L4 permits 2-point alignment with the usual interaction of such frequency adjustments.

R30 is a varactor-bias adjustment and, by the nature of the varactor control characteristics, permits the sag or deviation from the desired characteristic to be adjusted in the center of the frequency range. This, of course, interacts with the other adjustments, so that all adjustments are most readily made by repetatively step scanning the oscillator through its range, by an automatic programmer, and observing the error voltage in the lock loop at TP1 (terminal 18) with an oscilloscope.

R54 is the fourth set-up adjustment and is used mainly to compensate for d-c offsets in the sampler and d-c ampli-

fier. This permits the establishment of a precise level on input terminal 29 for sweep-mode operation.

The sweep mode is enabled by programming 8 + 2 on the BCD input. The integrated circuit, U1 on the SSE board, senses the presence of this command and opens the +5.6-V supply to the pulse generator on the ED board, by means of switch transistor Q1 and, at the same time, a negative current source, Q3, is turned on via inverter-switch transistor Q2. The current source forward biases switch diodes CR1 and CR2, between the external sweep input at C2 and ED board terminal 29. Except for a small difference due to different currents in CR1 and CR2, the voltage applied at terminal 29 is equal to that applied at C2, with temperature characteristics of the diode drops compensated.

With no 5.6-V supply, the sampling pulse is not generated and the dc amplifier on the ED board goes into a saturated positive output condition, due to normal input offset permitted by the diodes in the undriven sampler. At the same time, the one-of-ten decoder is receiving an illegal command (8 + 2), which opens the circuit to all controlled resistors in the precision voltage divider. This permits the remaining resistors to supply a maximum d-c voltage to the oscillator varactors, which would set the frequency well above its normal range, if not restrained by the voltage at terminal 29.

Actually, the negative current available from the current generator on the SSE board is more than sufficient to pull the oscillator frequency well below its lower limit, if it were not for the fact that the part of this current comes from the external source at C2, via CR2 on the SSE board. As previously noted, the voltage at terminal 29 is essentially that applied to C2 and search/sweep can be applied from an external source. When 8 + 2 is not present on the BCD control line, normal operation is restored and CR1 and CR2 on the SSE board are heavily back biased by R9, isolating both the output and input of the switch.

A common external source drives the C2 connections to all oscillators in the instrument, in parallel with the selection of the decade to be searched entirely by a 2 + 8 input command on its frequency-control lines.

4.3.3 EW, 30-MHz Digit Oscillator Sampler (Figure 6-9)

Section EW carries the 1169-4094 board (EWA) with the reference pulse generator, sampler, and high-level r-f loop amplifier for the 30-MHz digit oscillator. The circuits on this board are similar to those described for the EU and EV sections, except they operate at considerably higher levels. The reason for the higher levels is to keep the phase-noise contribution of this digit oscillator within acceptable limits at the output of the synthesizer. (The oscillator for the next lower digit is followed by a divide-by-10 frequency divider and consequently could have 20-dB higher phase noise for an equivalent contribution to the over-all noise of the instrument). The reason for the separate enclosure for this part of the circuit stems from the requirement of keeping spurious contributions low, with the higher sampler level, without the help of frequency division following the oscillator.

The 1-MHz reference pulse generator is quite similar to that described for sections EU and EV, except that an additional amplifier stage, Q7, is added at the output to produce the high-level pulse needed to drive the reverse-biased-diode sampling bridge. The 1-MHz REF input enters at terminal 31. The 5.6-V supply to the pulse generator at terminal 33 is switched off by an SSE board in Section EX, when the sweep mode is enabled, to disable the phase-lock loop as described for Section EU and EV.

The sampling-diode bridge is reverse biased by plus and minus 2 V, developed across R22 and R21 by current from the +18-V and −12-V supplies. Multiple bypass capacitors in the feed networks isolate the power supplies from the high-level signals on the bridge.

The r-f OSC SAMP enters at terminal 7 and is amplified by a 2-stage grounded-base isolating-and-limiting amplifier, consisting of Q8 and Q9, to a level of 8 dBm into R45, at the input to the sampling bridge. The output from the sampler is stored in C9 and in the coaxial line to, and a terminating capacitor in section EX. R24 is a high-frequency source termination for the coaxial cable to eliminate multiple reflections.

The OSC CONT output to the connecting coaxial cable to Section EX leaves the board at terminal 9.

4.3.4 EX, 30-MHz Digit Oscillator (Figure 6-10)

Section EX carries the 1169-4096 board (EXA) with the 30-MHz digit oscillator, Q1, associated buffers, BCD integrated-circuit inverter and decoder (with precision resistor network programmer), and the phase-lock dc amplifier. The description given for the 3-MHz Digit Oscillator in Section EU and EV is applicable here, except that the oscillator circuit is modified to operate at a higher level in the interest of low phase noise and a portion of the lock circuit is in Section EW. Also, there are 2 tuned traps between the d-c amplifier and the varactor at 1 MHz and 2 MHz, to null out spurious sideband components at these frequencies. The oscillator has the same trimming adjustments as described for Section EU and EV. There is an additional TEMP COMP adjustment. This is an adjustment on the contribution of the temperature dependent silicon diode drop in the bias feed to the varactors and it is used to center the capture range of the oscillator at temperature extremes.

The output of oscillator transistor Q1 is taken from its emitter by an isolating emitter follower, Q2, driving 2 separate common emitter amplifiers, Q3, and Q4, in parallel. Q4 supplies the OSC SAMP output at terminal 3, via an LC matching network. Q3 supplies the 30- to 39-MHz OUTPUT at terminal 27, via an LC matching network, low-pass filter and a fixed resistive attenuator. C11 sets the

tilt of frequency response, over the required range, for maximum flatness. As described for the other digit oscillators, R27 compensates for d-c offsets in the sampler and d-c amplifier to standardize the input required at terminal 29 when the oscillator is in the sweep mode. The 1169-4024 SSE board, shown in outline form in Figure 6-10, is shown in detail in Figure 6-8 and functions in this oscillator exactly as described in Sections EU and EV.

4.3.5 GX, 300 MHz Digit Oscillator Sampler (Figure 6-11)

Section GX carries the 1169-4053 board (GL) with the reference pulse generator, diode-sampling bridge, 70-MHz harmonic amplifier, d-c amplifier with linearizing network, and a lock-loop filter. The 10-MHz INPUT sinewave enters the board at terminal 36 and drives a step-recovery-diode pulse generator, CR5.

A shorted delay line, determines pulse duration. A portion of the pulse signal is fed to the 70-MHz amplifier via R53, which delivers the selected 70-MHz component to terminal 42. L1 and C28 are peaking adjustments. R46 sets the desired level at terminal 42.

The major portion of the pulse signal drives the diode bridge to produce a short sample of the digit-oscillator voltage received at terminal 39 from Section-GY, buffered by Q1. This sample is held by C15 (plus the input capacitance of the d-c amplifier) completing a sample-and-hold phase detector. The diode sampling bridge is split into 2 capacitively coupled parts to permit the DC PROGRAM INPUT from terminal 33 to be added to the voltage produced by the phase detector. The short samples of the r-f waveform are readily transferred through the small coupling capacitors to combine with the program voltage at the input to the amplifier.

The d-c amplifier employs a multiple diode nonlinear feedback network to compensate for the nonlinear control characteristics of the varactor diodes in Section GY. There are two adjustments to trim the high- and low-frequency ends of the frequency-control system. R43 adjusts current source Q11, to set the minimum bias on the varactor in Section GY and consequently trims the low end. R36 adjusts another current source, Q10 at the input to the d-c amplifier, to provide its input bias to minimize input ripple from the sampling process. The last break point, for CR6, is set by R17 providing the high-frequency trimming.

The high- and low frequency trimming adjustments are made by first setting the d-c program voltages provided by Section GY to 2.37 and 0.12 V for the 300- and 210-MHz steps, respectively, then adjusting R43 and R17 (in that order), to center the capture range of the lock loop at 210 and 300 MHz, respectively. This must be done with a particular oscillator board in Section GY. For this reason, factory adjusted replacement boards are supplied in pairs.

A loop filter completes the circuits in this section. It consists of an RC phase-lag network and a parallel LC 10-MHz notch filter, all with non-adjustable elements. The output from this filter leaves the section at terminal 15 to go to the OSC CONTROL INPUT OF Section GY.

4.3.6 Section GY, 300-MHz Digit Oscillator. (Figure 6-12)

Section GY carries the 1169-4010 board (GK) with the 300 to 210 MHz digit oscillator and associated buffer amplifiers for its phase-lock loop and main output, and a BCD d-c step programmer. The oscillator consists of oscillator transistor, Q3, with tuning inductor L4, and series-parallel-connected varactor diodes C27 thru C30. The OSC CONTROL INPUT enters at terminal 31 from Section GX and is fed to the midpoint of the varactors through an r-f isolating resistor and choke. L4 is initially adjusted for 210 MHz with 1.4 V applied at the OSC CONTROL INPUT.

The lock-loop buffer amplifier consists of 3 cascaded stages using transistors Q4, Q5, and Q6. The output from this buffer to Section GX leaves at terminal 14. R20 sets the output level. The buffer in main output to terminal 44 consists of a single transistor amplifier, Q2, followed by a low-pass filter and matching pad. R4 sets the output level at terminal 44.

The 8-4-2-1 BCD input enters at terminals 1, 3, 5, and 7, respectively, and is decoded to one of 10 switch closures by U1, U2, and Q7. This selects one of 10 voltages supplied by a series of potentiometers, R55 through R63 and R66. R66 sets the voltage supplied to the chain in series with fixed resistors R64 and R65. The selected voltage is the D-C PROGRAM OUTPUT to Section GX, which leaves Section GY at terminal 17. R66 is set to provide 2.37 V on step O (300-MHz step), then R55 is set to provide 0.12 V on step 9 (210-MHz step). After the low- and high-frequency trimming adjustments have been completed in Section GX, the remaining potentiometers are adjusted to center the capture range on each step.

4.3.7 Section H, Fine Resolution (Figure 6-13)

Section H is identified in the synthesizer as the FINE RESOLUTION SECTION, silk screened on its cover plate. This section is utilized only for the increased-resolution instruments, OP4A through OP4E. The required circuit-board configurations for the various resolution options are silk screened on the cover plate. In instruments with no resolution options, this section is bypassed in the chassis wiring and no mother board board is installed. The mother board is used, 1169-4090 (Figure 6-13), for the standard resolution options, OP4A through OP4E. If less than the maximum resolution is originally installed, it can easily be increased at a later date by removal of one or more plug-in bridging boards and installing the appropriate mixer-divider and digit-oscillator boards. To add a mother board requires a factory modification.

The mother board, 1169-4090, carries 5 sweep-enable circuits, described in Sections EU and EV, as well as the sockets to receive up to 5 mixer/divider boards and 5 digit-oscillator boards. The 1169-4044 digit-oscillator board, Figure 6-7, has already been described in Sections EU and EX. The 1169-4065 mixer/divider board is electrically identical to the 1169-4060 mixer/divider board, Figure 6-14, described in para. 4.3.8, Section J. The 1169-4080 bridging board replaces the 1169-4065 mixer/divider board in all its unoccupied stations to provide the 5-MHz input to the first active station, and loads the 42-MHz reference bus, similarly to the 1169-4065 board, to maintain the desired level. The unoccupied digit-oscillator stations are left vacant.

4.3.8 5.1 MHz Intermed. Mix/Div. (Figure 6-14).

Section J carries the 1169-4060 board (JA). The 1169-4065 (JC) board, used in the Fine Resolution Section, is identical electrically with the JA board, the difference being that it has lower sectional shields without attached grounding springs.

The JA board combines a 5- to 5.1-MHz input signal, carrying all lower-decade frequency information with the frequency of its associated 3- to 3.9-MHz digit oscillator, and delivers a signal with a frequency in the same 5- to 5.1-MHz range to subsequent decades. The combination forms a complete digit insertion-unit. Such units can be cascaded indefinitely to produce a decimally related series of frequency digits as outlined in para. 4.2.

The 5.0 to 5.1 MHz INPUT enters the board at terminal 41 and is fed to input mixer Q1 by a fixed-tuned transformer. A 42 MHz INPUT from Terminal 43 is amplified by Q2 and coupled by a tuned transformer (set by L2) to the input mixer, resulting in an up-converted 47 to 47.1 MHz output. This signal goes through a bandpass filter, adjusted by L3 and L4, to a 47-MHz amplifier, Q3. The output of Q3 passes through a tuned circuit peaked by L5 and forms the in-phase input to a balanced transistor mixer Q4 and Q5. The 3 to 4 MHz INPUT from the associated digit oscillator enters the board at terminal 19 and generates the push-pull input to the mixer, by means of balancing transformer T2. The up-converted push-pull 50 to 51 MHz output is coupled by a double-tuned circuit to the following frequency divider. The trimming adjustments for this circuit are C16 and L7, with L6 affording a balancing adjustment.

The frequency divider consists of U1 and U2 coupled by driver Q6, producing an over-all division-by-10. The resulting 5.0- to 5.1-MHz signal is filtered by a tuned-output transformer, adjusted by C26, and fed to terminals 2 and 3. Terminal 2 is grounded.

4.3.9 Section L, 47-MHz Intermediate Mixer (Figure 6-15).

Section L carries the 1165-4018 board (LA). It combines a 5- to 5.1-MHz input signal, carrying all 10-kHz steps and lower decade-frequency information with a fixed 42-MHz input to produce an up-converted 47- to 47.1-MHz output.

The 5.0 to 5.1 MHz INPUT enters the board at terminal 16 and is fed to the mixer, Q1, by a fixed-tuned transformer. A 42-MHz input from terminal 18 is amplified by Q2 and coupled by a tuned transformer (set by L2) to the mixer, providing an up-converted 47 to 47.1 MHz output. This signal goes through a bandpass filter, adjusted by L3 and L4, to 47-MHz amplifier Q3. The output of Q3 passes through a double-tuned circuit to the 47 to 47.1 MHz OUTPUT at terminal 3. Adjustments for this circuit are L5 and L6. R12, in the emitter circuit of Q3, sets the output level.

4.3.10 51-MHz Intermeidate Mixer. (Figure 6-16).

Section MT carries the 1169-4062 board (MB), which combines the 47 to 47.1 signal from Section L, with decade frequency steps of 10 kHz and smaller, with the 3 to 3.9 MHz in 100-kHz steps from the associated digit oscillator, to produce a 50- to 51-MHz output.

The 3- to 3.9-MHz digit-oscillator signal enters the board at terminal 18 and is attenuated in a fixed resistive pad and applied to one input of a double-balanced mixer, U1. The 47 to 47.1 MHz INPUT at terminal 16 feeds the other input port of the mixer. The resulting output is amplified by Q1, followed by a triple-tuned filter for the up-converted 50- to 51-MHz output. C5, C8 and C10 are used to adjust this filter. The output leaves the board at Terminal 3.

4.3.11 Section MO, Master Oscillator. (Figure 6-17)

Section MO uses moderate stability plug-in master oscillator (1169-4131) for option 2A or an 1169-4033 High Stability plug-in master oscillator (MO-10B) for option 2B. The

MO-10C furnishes a 5-MHz output, the MO-10B a 10-MHz output to Section RP, via terminal 4 when the INT, EXT. REF rear-panel switch is set to INT position. When this switch is set to EXT position, the drive must be supplied at the EXT REF INPUT rear-panel connector and the power supply to the master oscillator is turned off. EXT REF INPUT must be used when no master oscillator is installed. Both master oscillators can be controlled over a limited frequency range by a variation of d-c voltage at the DC FREQ CONTROL connector, which is applied to the oscillator via terminal 10. The nominal +8 V bias at this terminal is supplied at terminal 9, which is normally wired to terminal 10 by an internal jumper. The source resistance of the bias supply is 900 ohms, so it can easily be overridden by the external control source eliminating the need for any switching or removal of the jumper. A rear-panel pin jack permits the use of an external BAT for maintaining the oven temperature of the high-stability master oscillator during power interruptions. This input is supplied to the oscillator via terminal 8, with internal diodes CR1 and CR2 automatically transferring power sources for this operation.

4.3.12 Section OA, 500-MHz Output Amplifier (Figure 6-18)

NOTE

Section LDL, Level Detector Logic board and Section PM, PIN Modulator Assembly, also covered here (Figure 6-19).

Section OA carries the 1169-4052 (OAC) board, with the broadband output amplifier and an output automatic-level-control system. The broadband output amplifier uses transistor Q1 through Q5 to afford approximately 40 dB of gain and an output level of up to +13 dBm. It receives a .01- to 500-MHz input at terminal 43 from the Microwave Assembly, Section K. The output level is monitored by peak-to-peak rectifiers, CR1 and CR2, at input side of a 50-ohm precision resistor in series with the output to an SMA connector, J2. This connector is attached to a short, semirigid, coaxial cable and is part of the plug-in assembly, but a removable nut is used to mount it firmly to the bottom of the enclosure base assembly. Both this nut and two screws to the attached heat sink and shield must be removed from the bottom of the instrument before the board assembly can be unplugged from the top. A flexible coaxial cable, with a mating SMA connector, carries the output from the OA Section to either the front or rear panel of the synthesizer.

In the interest of maintaining maximum speed of response in the level-control system, the time constant of the level detector is switched in 3 separate ranges, along with the frequency selected. This is accomplished by FET switches Q6, Q7, Q10, Q11, and Q15, driven by Q8, Q9, Q12, Q13, Q14, and Q16 with signals entering the board at terminals 2 and 4. These signals are produced by an external Level Detector Logic Board, 1169-4057 (LDL), which senses the programmed frequency and provides appropriate outputs when the frequency is less than 400 kHz and less than 100 kHz. Above 400 kHz, the level detector has a minimum time constant set by C22, C24, C21 and C23, and L5 is connected by Q16 to raise the amplifier low-frequency cut off to minimize switching transients. When the frequency is less than 400 kHz, L5 is switched out and C25 and C26 are switched in parallel with C21 and C23, and when the frequency is less than 100-kHz, C27 and C28 are also switched in. On this lowest range, Q14 and Q15 switch in an additional capacitor, C37 in the output ALC amplifier, U2, to maintain control-loop stability.

U1 combines the plus and minus polarity signals from CR1 and CR2 and provides a positive-polarity standardized output to U2. U2 compares this signal with the POS LEVEL PROG input at terminal 10 and supplies an amplified error signal at terminal 12, ALC OUT. This output is used to control the loss of the external PIN diode modulator, 1169-4160, (PM), which indirectly controls the level of the signal delivered to the input at terminal 43, thereby closing the level-control loop. Terminal 8 is normally connected via a jumper to ground but can be connected to −12 V at terminal 6 to provide a +10 dBm output with zero dc on POS LEVEL PROG INPUT.

A LEVEL MONITOR output at terminal 18 is also available at the rear panel AUX LEVEL PROG connector of the synthesizer, along with connections to the ALC OUT and POS LEVEL PROG terminals, for test purposes and for use in special systems applications.

C9 adjusts the high-frequency response of the broadband output amplifier. R72 and R74 are the HI CAL and LO CAL adjustments used to standardize the d-c levels for the POS LEVEL PROG input at terminal 10 and are set so that the rms r-f output into 50 ohms is equal to ¼ the applied programming d-c voltage over an r-f voltage range of 0.1 to 1.0 V (−7 to +13 dBm). R74 is really a zero adjustment but is offset slightly for best tracking over the 20-dB range.

The Level Detector Logic board (LDL), 1169-4057, (Figure 6-19), is mounted at the center-bottom of the left side member of the chassis. It receives inputs from the X100-MHz step program to Section K, the X10-MHz step program to Section GY, the X1-MHz step program to Section EX, and the X100-kHz step program to Section EV. Integrated-circuit gates compare these inputs and provide a "low" output at terminal 19, when the selected frequency is less than 400 kHz and a "low" output at terminal 18, when the selected frequency is less than 100 kHz. These outputs feed Section OA to provide the time-constant switching previously described.

The PIN Modulator Assembly (PM), 1169-4160 is mounted at the front-bottom of the left side member of the

chassis. Its RF IN at J1 comes from the UHF Section, 1169-4140, 500 to 510 MHz output. This input is attenuated by a resistive padder, then by the voltage-controlled attenuator, consisting of series diodes CR1 and CR3 and shunt diodes CR1 and CR4, and then by another resistive padder to RF OUT at J2. The control input enters at C3 and is the ALC output from Section OA. The 500 to 510 MHz RF OUT at J2 provides the 500- to 510-MHz input for Section K, Microwave Assembly, 1169-4180, whose .01- to 500-MHz output bears a linear relationship to the 500- to 510-MHz input level. This output is amplified by Section OA and the Automatic Level Control is established as previously described.

4.3.13 Section P, Phase Modulator. (Figures 6-20 — 6-21)

Section P carries two boards. One of these boards is the 1169-4008 Phase Modulator board (PC). The other board is the 1165-4022 420 MHz board (PB). The 1169-4008 board (PC) receives a 70-MHz input from Section GX via terminal 2, filters, amplifies, inserts phase modulation (applied via terminal 22), and delivers the phase-modulated 70-MHz signal to the PB board, via terminal 26. The PC board carries an input resistive attenuator, 3-pole bandpass filter, buffer amplifier, Q1, linearized phase modulator with varactors, CR1 and CR2, FET buffer amplifier Q2, output amplifier, Q3, and a direct-coupled modulation amplifier, Q4, Q5, and Q6. L1, L7, and L2 adjust the bandpass filter, L6 peaks the output amplifier, and R29 adjusts the sensitivity of the phase modulator.

The 1165-4022 board (PB) receives the 70-MHz input from the PC board via terminal 2, multiplies the frequency by 3 and 2 and delivers a 420-MHz output, via terminal 23, to the UHF Section. The PB board carries tripler transistor Q1, a 210 MHz 2-pole bandpass filter, and output doubler transistor Q2. C4 and C6 adjust the bandpass filter and C7 peaks the doubler output circuit.

The enclosure base for Section P has a 70-MHz output, obtained from the 70-MHz input to terminal 2 of the PC board by a 12-pF coupling capacitor. This output, 6A, feeds the 70-MHz input to Section RD.

4.3.14 Section RB, Reference Buffer. (Figure 6-22)

Section RB carries the 1169-4048 Reference Buffer Board (RBA). This board receives a standardized 10-MHz input from Section RP, via terminal 5, delivers 10 MHz by 3 separately buffered outputs, to Section G via terminal 1, to Section RD via terminal 15, and to the 10-MHz OUT, rear-panel connector, via terminal 18. The RB board carries tuned-output buffer amplifier Q4, for terminal 1, intermediate-tuned buffer amplifier, Q3, and tuned output buffer amplifier Q1 and Q2 for terminals 18 and 15, respectively. C19 peaks output at terminal 1, C11 peaks the intermediate buffer, and C3 peaks output at terminal 18.

4.3.15 Section RD, Reference Divider. (Figure 6-23)

Section RD carries the 1169-4006 Reference Divider Board (RDA). This board receives 70 MHz from Section P, via terminal 2, and 10 MHz from Section RB, via terminal 9. The 70-MHz input is amplified by IC buffer, U1 then frequency divided-by-5 in U2 and U3, and the resulting 14-MHz signal delivered to Section RM, via terminal 5. The 10-MHz input feeds decade divider U 4 which produces one 5-MHz and 3 separate 1-MHz outputs. The 5-MHz output is fed, via a low-pass filter and terminal 13, to Section J or Fine Resolution Section H. The 1-MHz rectangular-waveform outputs are fed to Section EW via terminal 19, Section EU via Terminal 15, and to Fine Resolution Section H via terminal 17. The 1 MHz OUT at the rear-panel connector is obtained from the last output by a series isolation resistor in Section H. C2, peaks the 70-MHz input to U1.

4.3.16 Section RM, Reference Multiplier. (Figure 6-24)

Section RM carries the 1169-4000 Reference Multiplier Board (RMA). This board receives a 14-MHz input from Section RD, via terminal 5 and delivers a 42-MHz output, at terminals 15 and 18, to Sections J and H. It delivers an isolated 42-MHz output, at terminal 1 to Section L, and to the 42-MHz rear-output connector, via an additional series-resistor isolator in the chassis. A separate X3 frequency multiplier and output amplifier is used for the output at terminal 1, consisting of Q2 and Q1, respectively. Q3 is a common input buffer. The X3 frequency multiplier and output amplifier (for terminals 15 and 18) consist of Q4 and Q5. C5 peaks the output of Q2, C1 and C23 tune the double-pole filter at the output of Q1. C14 and C18 peak the outputs of Q4 and Q5, respectively.

4.3.17 Section RP, Reference Processor. (Figure 6-25)

Section RP carries the 1169-4046 Reference Processor Board (RPA). This board receives a 5- or 10-MHz signal from Section MO or EXT REF INPUT, with a wide range of levels, and delivers a filtered 10-MHz signal at a standardized level to Section RB. The input enters at terminal 18 and drives amplifier Q1 via a lightly forward-biased diode, CR1. CR1 distorts a 5-MHz drive signal to provide a 10-MHz component in the output of Q1. The output of Q1 is tuned to 10 MHz and CR1 and CR4 provide amplitude limiting. Q2 and Q3 furnish additional limiting by being alternatively switched by the 10-MHz signal from Q1. Q3 drives a 10-MHz double-pole bandpass filter with fixed current pulses, set by the value of the common-emitter resistor for Q2 and Q3. The output of the bandpass filter feeds amplifier Q4, which drives the 10-MHz monolythic crystal filter in the output to Section RB at terminal 2. L2 and L3 adjust the double-pole bandpass filter. R9 sets the output level to section RB.

4.3.18 Section SS, Search Sweep Driver. (Figure 6-26)

Section SS Consists of the 1169-4022 Search/Sweep Driver Board (SSA) mounted near the panel of the instrument, at the lower left side. This is not a plug-in board but is permanently wired to the SWEEP IN connectors by semirigid coaxial cables. In manual option instruments, additional connections are wired into the panel controls. This section sums, without interaction between sources, the two rear inputs and the voltages from the panel controls and (from WT6) drives all the sweep-input terminals of oscillators in the synthesizer. The transfer characteristic is designed to compensate for the nonlinear control characteristics of the oscillators, so that a linear over-all sweep-input-voltage-to-frequency characteristic is obtained.

Separate discrete-component operational amplifiers (3) are used to meet the requirements for low noise, wide bandwidth, and large but limited output-voltage swings. The first operational amplifier consists of Q1 and Q2 and is used in the inverting mode to sum the 2 rear panel inputs, at WT8 and WT10, and the outputs of the front-panel controls when used.

The second operational amplifier, consisting of Q3 and Q5 is used to reinvert the control signal and add in some offset and temperature compensation emanating from Q4. Q10 is a limiting emitter follower used to prevent the output voltage from going below a minimum acceptable level for the digit oscillators. Precision resistors R7 and R8 set the limiting point.

The output operational amplifier, consisting of Q6, Q7 and Q8, is used in the noninverting mode and employs a nonlinear feedback network, composed of offset-biased diodes CR1, CR2, and CR3, and precision resistors. The temperature characteristics of the diodes is compensated by the temperature characteristic of bias-feed transistor, Q9. All precision resistors involved in the circuit are part of a precision thin-film network, Z1. R28 sets the offset bias at WT6 with zero sweep input voltage. R38 permits the break points of the diode network to be changed slightly for best match to a linear control characteristic. Q8 is mounted in a socket for easy replacement and acts like a fuse to protect the circuit from accidental short-circuits on its output terminals.

4.3.19 Section UHF. (Figures 6-27 — 6-30)

The UHF Section is mounted on the bottom of the instrument chassis and is the complete electro-mechanical assembly, 1169-4140, shown in **Figure 6-27.** This section combines the 50- to 51-MHz signal, with 100-kHz and smaller digit steps, from Section MT with the 1-MHz/step 30- to 39-MHz signal from Section EX to provide the 500 to 510 MHz input signal for section PM.

The UHF Section carries 3 built-in comb-line bandpass filters, a 3-pole for 420 MHz, a 4-pole for 470 MHz and a 6-pole for 510 MHz. These filters are aligned at the factory, using swept frequency techniques, and field alignment should not be required, unless the assembly has suffered physical damage, in which case the entire assembly should be replaced as a unit. It also carries a thin-film 510 MHz low-pass filter.

The remaining circuits in the assembly are carried by separate etched-circuit boards, screw mounted and hard wired into the assembly. The schematics for these circuits are shown in Figures 6-28, 6-29, 6-30. All signal interconnections between the separate board assemblies are made with semirigid coaxial cables.

The 50- to 51-MHz signal from Section MT enters the UHF Section via P6 and a semirigid coaxial cable. It enters the 1169-4036 Intermediate Amplifier Board (IAC) at WT-1 and is amplified by a cascode-amplifier, using Q1 and Q2, then goes through a 3-pole bandpass filter to board output at WT-3. R7 is set to obtain a standardized level at the output of the 470-MHz bandpass filter. C6, C9, and C11 adjust the 3-pole bandpass filter.

The 50- to 51-MHz signal from the IAC board enters the 1169-4098 Mixer Board (MXB) at terminal 1 and feeds the signal port of a double-balanced mixer, U1, after passing through a resistive attenuator. The "local-oscillator" input for this mixer comes from Section P via P7, a semirigid coaxial cable and the 420-MHz bandpass filter. J6 provides access to the filter output for test purposes. The 470- to 471-MHz output of MXB leaves the board at terminal 3 and goes to J2, at the input of the following Intermediate Amplifier, 1169-4026.

The 470- to 471-MHz signal from J2 feeds the 1169-4026 Intermediate Amplifier Board (IAB), where it is amplified by Q2 and Q1 and applied to the input of the 470-MHz bandpass filter. C6 and C9 are the peaking adjustments for the IAB board.

The input and output of the 470 MHz bandpass filter are accessible for test purposes by connectors J3 and J5.

The 470- to 471-MHz output of the 470-MHz bandpass filter enters the 1169-4095 Mixer Board (MXD) at terminal 2 to provide the "local-oscillator" input to double-balanced mixer, U-1. The 30- to 39-MHz "signal" input to this mixer enters at terminal 1 via J8 from Section EX. The 500- to 510-MHz output goes via terminal 3, to the 510-MHz bandpass filter. The input and output of this filter are accessible for test purposes by connectors J4 and J7.

The 500- to 510-MHz output from the 510-MHz bandpass filter feeds the input of the 1169-4030 Intermediate Amplifier Board (IAA) via J10 and a series resistor. A major portion of the input to J10 and leaves the section via J9 for the rear-panel 500 to 510 MHz output connector. The IAA board carries a 3-pole broadly-tuned amplifier, Q1, Q2, and Q3, whose output leaves the UHF Section at J1, after passing through the 1169-1000, 510 MHz Low-pass Filter, and feeds Section PM. C14 and C13 adjust the frequency response of the amplifier.

4.3.20 Section V, Power Supply. (Figure 6-31)

Section V is the 1169-4110 Power Supply, which is a removable assembly in the synthesizer, carried by the upper portion of the rear panel. All electrical connections to the main body of the instrument are made by a plug attached to the main power cable. The mechanical mounting is by screws through the 2 side frame members of the chassis and by screws at the top-front of the assembly. The circuits in the synthesizer require separate power sources of −12 V, +5.6 V and +18 V, all from the single power supply assembly.

Circuits for the 1169-4110 Power Supply are carried by the 1169-4050 Rectifier Board (VA), mounted on the Power Transformer, and the 1169-4055 Regulator Board (VB), mounted on the heat-sink assembly with the series-pass power transistors. The heat sink and regulator board assembly is removable as a unit from the rear panel with a sufficiently long flexible interconnecting cable to permit operation in this extended condition for trouble-shooting access. An additional separation of the regulator board can be made for further accessibility.

The tapped power-transformer primary and associated selector switch permit selection of a wide range of operating voltages. The regulating circuits maintain constant supply voltages to the rest of the synthesizer, with line voltage variations of up to ±10% around the center of the selected range. All supply voltages are referenced to that of the −12-V supply, which uses an integrated-circuit regulator, U1. A separate series-pass transistor, Q2, mounted on the heat sink, is used for this supply. R13 and Q14 provide current-limiting sensing for the −12-V supply. The voltage-sensing leads for this supply, as well as the other two, are taken through the interconnecting plug to the load side, to eliminate the effect of contact resistance.

Q1, in the +5.6-V supply, compares the voltage developed at its output with that of the −12-V supply (by means of R5, R6 and R7) and supplies an error signal, which is amplified by Q3, Q4 and Q5, to control series-pass transistor Q1 on the heat sink. R1 and Q15 provide the current-limiting sensing to protect this supply against short-circuits.

Q7 in the +18-V supply compares the voltage developed at its output with that of the −12-V supply (by means of R22, R23 and R24) and supplies an error signal amplified by Q9, Q10, and Q11 to control series-pass transistor Q4, via Q3 both on the heat sink. R19 and Q13 afford the current-limiting sensing to protect this supply against short-circuit. Boosted bias voltage for Q11 is provided by a separate rectifier system, using CR9, CR10, CR11 and CR12 on the rectifier board. A similar boosted bias for U1 in the −12-V regulator, filtered by R12 and C4, is provided by +5.6-V rectifier and the +18-V supply boosts bias for all the amplifier circuits in the +5.6-V regulator, via R30 and C14.

R15 and R16 are the coarse and fine voltage-setting adjustments for the −12-V supply. R6 is the adjustment for the +5.6-V supply and R23 is the adjustment for +18-V supply. These adjustments are accessible from the rear of the instrument by removing the cover plate of the transistor heat sink. The −12-V adjustment must be made first, then the 18-V adjustment, and finally the +5.6-V adjustment. Appropriately labeled pin jacks are available on the rear panel to check each of the supply voltages. No adjustment should be attempted, unless a monitoring voltmeter with accuracy of a few millivolts is used.

4.3.21 Section K, Microwave Assembly. (Figures 6-32 — 6-34).

The Microwave Assembly, Section K, is mounted on the bottom of the instrument chassis and is the complete electromechanical assembly, 1169-4180, shown in Figure 6-32. Most of the circuits for this section are embodied in the microcircuit assemblies, 1169-4181 (KA), 1169-4182 (KB), 1169-4183 (KC), and 1169-4184 (KD), which are enclosed in a sealed-bottle portion of the assembly that is filled with an inert gas for the protection of the thin-film circuits. Repairs to this portion of the assembly are best handled at the factory where proper facilities for evacuating and back filling the bottle are available.

All connections to the circuits inside the bottle are clearly identified by a silk-screened diagram on the assembly. The other circuits carried by the assembly are closely related to the circuits inside the bottle and all adjustments, with the exception of those of the Interdigital Bandpass Filter, are made on the complete assembly. The 1169-4135 Interdigital Bandpass filter is aligned at the factory, using swept frequency techniques, and field alignment should not be required unless the assembly has suffered physical damage, in which case it should be replaced as a unit.

The remaining circuits in the assembly are carried by 5 etched-circuit boards, screw mounted and hard wired into the assembly. The schematics for these circuits are shown in Figures 6-33 and 6-34. All signal connections into and from the assembly are made with semirigid coaxial cable, with SMA connectors.

The Microwave Assembly receives the 500- to 510-MHz output (with digit steps of 1-MHz and smaller) from Section PM at J40. The 300- to 210-MHz output from Section GY (with the 10-MHz digit steps) enters at J47. A 10-MHz reference pulse from Section GX at J8, adds the 100-MHz digit steps, through the step-programmed microwave oscillator. Combined, the signals deliver the required .01 to 500 MHz synthesized output at J42 to Section OA.

Section K also provides the auxiliary rear-panel outputs of 2.3 to 2.2 GHz, via J41, and of 1.8 to 2.2 GHz, via J45. (See also Figure 6-4.)

The 100-MHz step-programmed microwave oscillator is part of the 1169-4183 (KC) microcircuit assembly in the bottle. It consists of a 1770 to 2170 MHz varactor-tuned oscillator with an associated buffer amplifier and power-splitting hybrid. The step voltage control for this oscillator comes from the 1169-2974, 100-MHz step-program assembly, outside the bottle. This assembly also provides temperature compensation for the oscillator, through the use of temperature-sensing diodes mounted on the microcircuit assembly.

The 1169-2974 100-MHz Step-Program Assembly is mounted in a magnetically shielded enclosure, in close relationship to the associated input connections to the bottle, in the interest of keeping magnetically and electrically coupled spurious-frequency components off the microwave signal. The circuits for this assembly are carried by 2 etched-circuit boards. Source Board 1169-4068 (KF) carries 2 discrete-component operational amplifiers and a voltage-reference source using Zener diodes.

This board also carries all the adjustable potentiometers, 5 for the frequency steps, 2 for adjusting the amount of temperature compensation on the 2 lower steps, and 2 setup adjustments for the circuit. These adjustments are accessible through holes in the enclosure, from the bottom of the instrument. Silk-screened labels identify the function of each adjustment.

Q3 and Q4 amplify the variation of the voltage drop across the temperature-sensing diodes. Forward bias to the diodes is supplied by R7 and R6. The BAL adjustment, R9 sets the d-c output of Q3 and Q4 to match the voltage of reference diodes, VR2 and VR3, at an instrument ambient temperature of 25°C.

The TC0 and TC1 potentiometers set the relative portion of the fixed-reference voltage from VR2 and VR3 and the temperature-variable voltage from Q3 and Q4 that is supplied to the F0 and F1 potentiometers, respectively. The F0 potentiometer sets the voltage supplied for the 0 X 100 MHz frequency step and the F1 potentiometer sets it for the 1 X 100 MHz step. The TC0 and TC1 potentiometers are the temperature-compensation adjustments for these steps and, though normally set to the center of their ranges, may be used to increase or decrease the compensation as required. The BAL setup adjustment is made by alternately setting the TC0 adjustment to the extremes of its range and adjusting for no change in the 0 X 100 MHz step program voltage or VC0 frequency.

The F2 potentiometer sets the voltage supplied to the microwave oscillator for the 2 X 100 MHz step. No temperature compensation is required for this step. Q1 and Q2 amplify and invert the direction of variation of the voltage supplied by Q3 and Q4. The V MAX potentiometer sets the d-c output from Q3 and Q4 at a 25°C instrument ambient temperature. This adjustment is made by setting the F4 potentiometer at its maximum cw position and adjusting for 27.5 V output on the 4 X 100 MHz step. The F3 potentiometer sets the output voltage for the 3 X 100 MHz step. The F4 potentiometer sets the output for the 100-MHz steps. All precision fixed resistors on the KF board are part of precision-thin-film resistor networks, Z1 and Z2. The amount of temperature compensation for the 3 X 100 MHz and 4 X 100 MHz steps is fixed by resistance values in these networks. A positive voltage-temperature characteristic is required for steps 3 and 4, a negative characteristic for steps 0 and 1.

The 5 outputs of the KF Source board feed the 1169-4074 (KE) Switch board by wire ties at the rear of the boards. The KE board carries the FET switches for selecting the output voltage steps, associated drive transistors, and the integrated-circuit BCD-to-decimal decoder. There is also a switch transistor, Q10, which on step 2 only, supplies an output bias current to one of the microwave mixers in the bottle, via K-C4 and Section KH.

The step-program voltage leaves the program assembly via a coaxial cable at WT1 and WT2 on the KE board and feeds the terminals of the bottle that is connected to the + and − varactor terminals of the microwave oscillator inside. Notice that the − terminal of the varactor is connected to the −12-V supply, via the outer conductor of the coaxial cable and WT2 must not be grounded. All step output voltages at WT1 are referenced to this −12-V connection. The voltages supplied and the resulting nominal microwave VC0 frequencies are as follows:

Table 4-1

MICROWAVE FREQUENCY PROGRAMMING

4-2-1 Binary Program Input	Programmed X100 MHz Step	Minimum Voltage	Maximum Voltage	Nominal Frequency
0 0 0	0	5	7	1770
0 0 1	1	7	9	1870
0 1 0	2	9 6	12	1970
0 1 1	3	14 5	17.5	2070
1 0 0	4	23	27.5	2170
1 0 1	4	23	27.5	2170
1 1 0	4	23	27.5	2170
1 1 1	4	23	27.5	2170

The 0-, 100-, and 200-MHz reference frequencies required at bottle-input connector, J43, come from the 1169-4084 (KH) 100/200 MHz Output board, which is driven by the 1169-4082 (KG) 100-MHz Generator board, which is driven by the 10-MHz reference pulse that enters the assembly at J8 from Section GX. The 0 reference is the d-c bias from the 100 MHz Step Program Assembly. The KG board selects and amplifies the 10th harmonic of the 10-MHz input pulse. C3, C6, and C9 tune the input and double-tuned output circuit to 100 MHz. The KG board feeds the KH board by a short coaxial connection. The 100 MHz input is further filtered by a 3-pole bandpass filter on the KH board, to remove 10-MHz sideband components. This input drives a transistor amplifier/harmonic generator with an LC output network designed to equalize the amplitude of the 2 components. The bias input from the 100 MHz Step Program Assembly enters at WT-3 and is superimposed on the output at WT-1 by the R3, C13 filter network. This output feeds the KB microcircuit assembly in the bottle via J43. The 3-pole 100-MHz input filter is adjusted by C9, C10 and C15. R5 adjusts the 100 and 200 MHz output levels.

The +13-V regulated power source required by some of the microcircuit amplifiers in the bottle is obtained from the 1169-4088 +13-V Regulator board. Q2 is a series-pass transistor that drops the +18 V supply to the required +13 V. Q1 provides a temperature compensated low-impedance reference voltage for the base of Q2. This board also carries adjustable resistors, KJ-R5/-R6 in the bias feed to the KH board, which are set to make the level out of the interdigital filter on the 2X100 MHz step the same as on the other 100 MHz steps.

The signal processing in the Microcircuit Assemblies in the bottle is as follows:

The output of the power splitter of the 1770 to 2170 MHz X 100-MHz step microwave oscillator in the KC assembly feeds one input of the KB assembly and one input of the KA assembly. A coupler in the input to the KB Assembly supplies the 1.8 to 2.2 GHz rear-panel output via J45. The major portion of the input feeds the LO port of a double-balanced microwave mixer. The signal port of the mixer receives the 0-, 100-, 200-MHz input from the KH board via J43.

The output of the mixer feeds the Interdigital Band-Pass filter, via a microcircuit amplifier and J44. The nominal 1970-MHz output from this mixer is produced as follows:

Table 4-2

NOMINAL 1970-MHz OUTPUT PRODUCTION

X100 MHz Step	LO Freq.		Signal Freq.		Output Freq.
0	1770	+	200	=	1970
1	1870	+	100	=	1970
2	1970	+	0	=	1970
3	2070	–	100	=	1970
4	2170	–	200	=	1970

NOTE

Both 100- and 200-MHz signal frequencies are always present but, on the 2 X 100 MHz step, a d-c signal bias is applied that produces the LO output frequency.

The interdigital band-pass filter has a 10-MHz bandwidth but very high attenuation for the ±100-MHz and ±200-MHz components present in the mixer output. Since the VCO programmed frequency is always well within ±5 MHz of its nominal values, the filter transmits any frequency error as a deviation of the 1970-MHz frequency. The output of the Interdigital bandpass filter feeds the LO port of the microwave double balanced mixer in the KC microcircuit assembly, via J46 and a microcircuit amplifier.

The signal port of this mixer receives the 300- to 210-MHz signal from Section GY, via J47 and a 1000-MHz microcircuit low-pass filter. The resulting 2270 to 2180 MHz is filtered by a microcircuit bandpass filter and fed to the KD microcircuit assembly, where it is amplified to provide the LO input to the double-balanced mixer in this assembly. A microcircuit coupler at this input provides the 2.3 to 2.2 GHz rear-panel output via J41.

The 500 to 510 MHz signal input for this mixer comes from Section PM via J40. The resulting 1770 to 1670 MHz output is filtered and amplified to provide the signal input to the double-balanced microwave mixer in the KA microcircuit assembly. The remaining 1770 to 2170 MHz X 100 MHz step output from the VCO power splitter is the LO input for this mixer, with isolation afforded by 2 microcircuit amplifiers. The resulting 0 to 500 MHz is the synthesized output frequency, which feeds Section OA via a 500-MHz microcircuit low-pass filter and J42. Notice that any frequency error of the VCO is cancelled in this final down conversion, since equal frequency deviations from the nominal values appear at both inputs to the mixer.

Service and Maintenance—Section 5

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WARNING

Line voltage terminals are exposed when covers are removed. Exercise caution during trouble-shooting, adjustments, or repair.

5.1 GR FIELD SERVICE.

Our warranty attests the quality of materials and workmanship in our products. When difficulties do occur, our service engineers will assist in any way possible. If the difficulty cannot be eliminated by use of the following service instructions, please contact our Service Department (see last page), giving full information of the trouble and of steps taken to remedy it. Be sure to mention the serial, I.D., and type numbers of the instrument.

5.2 INSTRUMENT RETURN.

Before returning an instrument to General Radio for service, please contact our Service Department or nearest District Office, requesting a "Returned Material" number. Use of this number will ensure proper handling and identification. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay.

5.3 MAJOR COMPONENTS.

Figures 5-1 and 5-2 identify the major components of the unit with their corresponding locations.

5.4 GENERAL MAINTENANCE.

5.4.1 Plug-In Etched Boards.

Detailed instructions are included in this manual to isolate a malfunction to a particular etched-circuit board or group of boards. Because of complexity and the difficulty in troubleshooting down to the detail-part level, it is strongly recommended that repairs be handled by replacement of the circuit board. For those who desire to troubleshoot to the detail-part level, information such as voltages and waveforms on the schematic drawings, parts lists, and the circuit description (in the theory section) are supplied.

NOTE

The following boards must be replaced in pairs. A single part number is provided for each pair.

1169-4094 Sampler Board (EWA)
1169-4096 Oscillator Board (EXA) P/N 1169-4800

1169-4053 Sampler Board (GL)
1169-4010 Oscillator Board (GK) P/N 1169-4806

In order to expedite the repair or replacement of the defective etched-circuit board(s) use the following procedure: Contact your nearest General Radio repair facility and supply them with the type, serial number, and identification (I.D.) number of the instrument, the part number of the defective board(s), and a purchase order number. The P.O. number allows for billing, if the unit is out of warranty, and for identification to expedite replacement. The repair facility will arrange for a replacement to be shipped as quickly as possible. Return the defective board(s) in the packing supplied with the replacement(s), or equivalent packing, to prevent further damage to the board(s). Please identify the part, with the "Returned Material" number on the tag furnished with the replacement, and return the defective part to the address on the tag.

5.4.2 Etched-Board Removal/Repair.

In order to isolate a circuit failure in the instrument it will usually be necessary to remove one or more etched-circuit boards to gain access to the internal signal paths. This is done by first removing an enclosure cover by

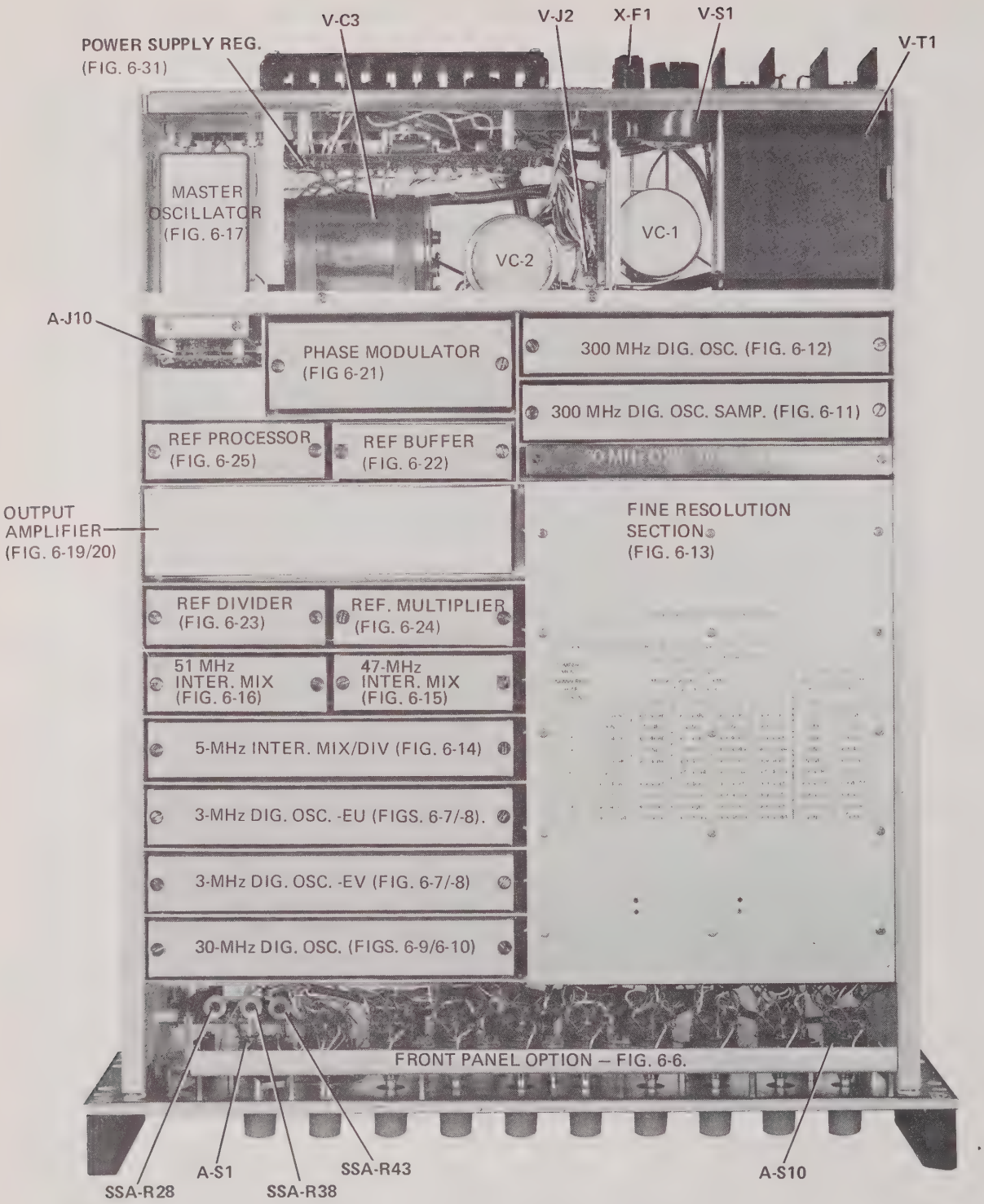


Figure 5-1. Top interior view, all options.

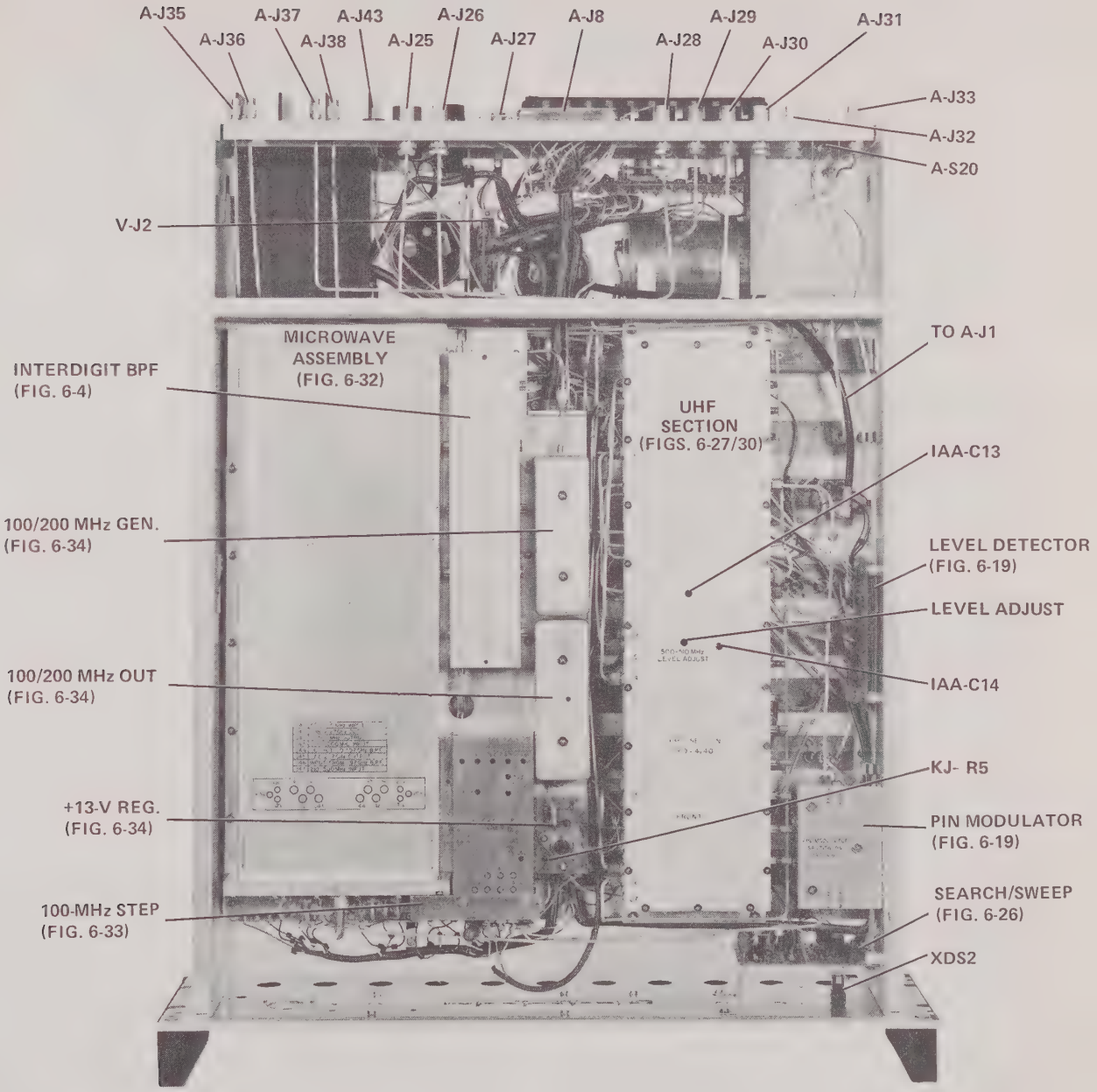


Figure 5-2. Bottom interior view — less option OP1, OP2A and/or OP2B.

alternately backing off (turning ccw) the two cover screws until the cover is free of its base. The board or boards in that enclosure can then be removed by prying gently, in the two holes at the top edge of the board, with a small screwdriver or soldering aid.

To remove the 500-MHz Output Amplifier, the SMA connector mounting nut must be removed from the bottom of the chassis, after disconnecting the flexible output cable as well as the 2 heat-sink screws.

Since individual boards are more easily tested and adjusted in special test fixtures at the factory, it is recommended that field repair consists of replacement of any defective board with a prealigned one. Prealigned etched-circuit boards can be obtained from the factory or, in most instances, at the nearest General Radio District Office.

5.4.3 Subassembly Removal.

Power Supply (1169-4110). To service the VA Board or power transformer, it is necessary to remove the complete power-supply assembly. Following is a procedure that can be used:

a. Unplug the Power-Cable-Connector Board (A-P2) and demount rear output connector, if in place.

b. Place the instrument top-side-up.

c. Remove the screws 0.190-32 (1) and 0.138-32 (4) that hold the power transformer and rear-panel in place.

d. Remove the 0.138-32 (2) screws from the top of the capacitor assembly (near the large capacitors).

e. Carefully pull the power-supply unit straight away from the rear of the instrument.

f. Access to the VA board is obtained by removing the 4 transformer-heat-sink screws from the rear and sliding the transformer shield off to the side.

Master Oscillator Unit. The master oscillator (section MO) can be removed by the following procedure:

a. Remove the 0.138-32 (2) screws from mounting bracket at the top-front of the oscillator unit.

b. Unplug the assembly by pulling upward.

c. Tip up the rear of the oscillator unit, and withdraw the unit through the opening in the partition from the top of the instrument.

Front-Panel Circuits. Better access to the circuits associated with the front-panel controls can be gained by the following procedure:

a. Remove the nuts that secure the side frames to the front panel.

b. Carefully tilt the front-panel in a direction that will allow access to the necessary component.

5.4.4 Knob and Bushing Removal.

To remove the front-panel control knobs and bushings, either to replace one that has been damaged or to replace the associated control, proceed as follows:

a. Grasp the knobs firmly with the fingers close to the panel and pull straight away from the panel.

b. Remove the handles from the front-panel by backing off the four 10/32 screws, two for each handle.

c. Remove the GR874 output connector by backing off the knurled ring and pulling the connector out of the panel from the rear.

d. Loosen the FREQUENCY SELECT locking screw and remove the slotted control.

e. Remove the ½-in. nuts (3) that hold the panel potentiometers in place. Set the frequency switches to the zero position and remove the dress panel without moving the dials.

f. Use a 3/16-in. Allen wrench to release the setscrew and pull the bushing off the shaft. The dial, marked with numerals 0 through 9 for frequency indication, is fixed to the bushing and will be removed with it.

When the front panel is removed, note that the frequency dials overlap and two different size bushings are used. Be sure to replace the dial assemblies in the same order that they were removed.

5.4.5 Knob and Bushing Installation.

To install a knob and bushing assembly proceed as follows:

a. Mount the dial and bushing assembly on the switch shaft, in proper relative position noted above, but do not tighten the setscrew.

b. Replace the dress panel and secure in place.

c. Pull the dial forward and center the zero in the dress-panel window.

d. Tighten the setscrew and check to see that the bushing does not bind when rotated.

e. Reverse steps b, c, and d of paragraph 5.4.4.

f. Place the knob on the bushing with the retention spring opposite the setscrew.

g. Push the knob in until it bottoms; pull it slightly to check that the retention spring is seated.

5.4.6 Frequency-Switch Removal.

To remove a switch assembly proceed as follows:

a. Set the switch to zero.

b. Remove the knob and loosen the bushing setscrew.

c. Unsolder the black wire connected to the frequency switch mounting bracket and any wires connected to the adjacent switches. Label the wires as they are removed so that they can be identified for reassembly.

d. Loosen the ½-in. nut that holds the switch in place.

e. Disengage the frequency select switch lug from the metal bar connected to the third switch wafer from the front panel.

f. Pull the switch out of the panel from the rear. If the switch is to be replaced, it is suggested that the wire connections be transferred from the original to the replacement, one at a time, to insure proper connections.

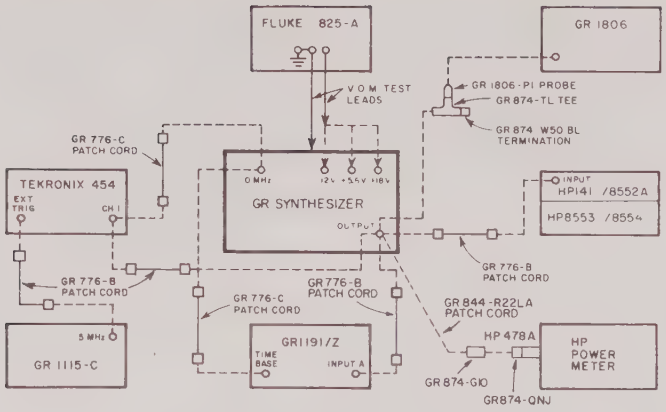


Figure 5-3. Test Set-up.

5.4.7 Frequency-Switch Installation.

To install a switch assembly proceed as follows:

a. Insert the switch, shaft-end first, through the switch-mounting bracket, ½-in. lockwasher and nut, and then through the front panel and bushing assembly.

b. Observe that the outboard end of the shaft has a flat side, (except A-S1). Set the switch to 0 by rotating the shaft so that the flat side is up. (Set A-S1 at ccw stop.) Tighten the ½-in. nut.

c. Rotate the dial assembly so that "0" is centered in the front-panel window; pull forward until the teflon washer (not visible) is bearing lightly against the inner surface of the dress panel.

d. Tighten the bushing setscrew securely to the switch shaft.

e. Replace the knob as directed in para. 5.4.5 steps d and e.

f. Solder the ground wire, and any wires removed from the original switch, to the proper terminals of the replacement switch.

5.4.8 IC Removal/Installation.

Socket Mounted. IC's that are mounted in sockets can be removed by insertion of a small-bladed screwdriver under the end of the IC and gently prying the IC up out of its socket.

When installing an IC in a socket, put all the leads from one side of the IC in the socket first and push the IC to that side until the leads on the other side line up with their socket holes. Push these leads into the socket and release the IC.

Board Mounted. An IC can be removed from an etched-circuit board with a soldering iron and a solder sucker (such as a Soldapulit*). Clean the solder from each pin on the IC and remove the IC from the board.

*Registered trademark of Edsyn, Inc., 15954 Arminta St., Van Nuys, California, 91406.

Insert the new IC in the holes left by the old one, and solder each pin. Be careful not to burn the etched-circuit board.

5.5 MINIMUM PERFORMANCE STANDARDS.

5.5.1 General.

Perform all checks in para. 3.4 to establish that the synthesizer meets minimum performance standards. The following additional checks may also be used. Refer to para. 5.6 if unable to obtain the performance called for in the minimum performance procedure.

5.5.2 Test Equipment.

The equipment listed in Table 5-1 is recommended for the ensuing tests. Figure 5-3 shows a test setup using this equipment.

5.5.3 Output Frequency Range.

The proper-frequency-generation check (para. 3.4.2) offers a convenient procedure to verify generation of proper frequencies. Connect equipment as shown in Figure 5-3 and make additional checks as follows:

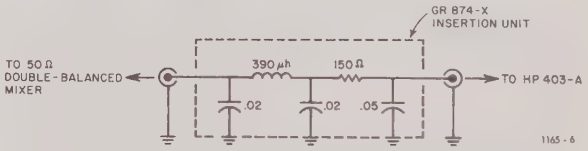


Figure 5-4. Low-pass filter (15 kHz).

a. Connect the output of the unit to the 1191/Z counter. Use the GR 776-B patch cord.

b. Connect the counter rear-panel TIME BASE connector to the synthesizer rear-panel 10 MHz OUT connector.

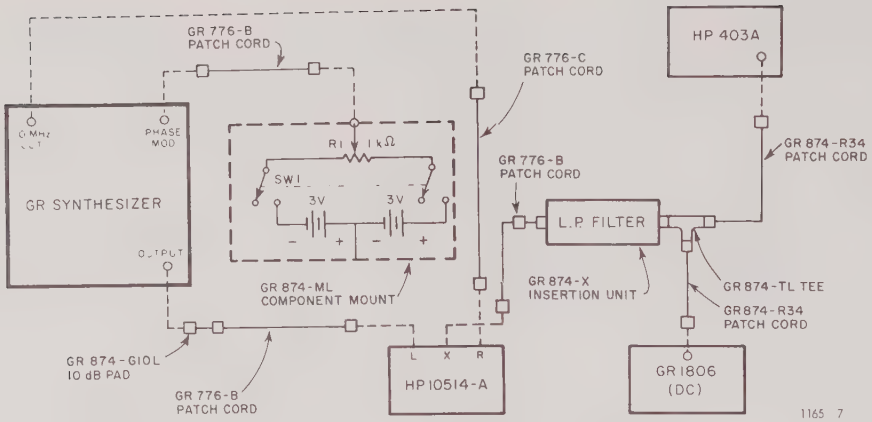


Figure 5-5. Phase- and amplitude-noise modulation measurement setup.

This locks the counter time base to the master oscillator. Use the GR 776-C patch cord.

c. Set the X10-kHz dial to "1" and the other dials to "0".

d. Set the counter to measure frequency with a 1 sec counting time. The counter should indicate 10 kHz ±1 count.

e. Advance the X 1 Hz dial through each step from "0" to "9". Notice that the counter indication increases by 1 count with each step.

f. Repeat the observations at step-digit settings for the X10 Hz, X100 Hz, X1 kHz, X100 kHz, X1 MHz, and X10 MHz dials and observe the counter indication. To check the 0.1 Hz steps use a 10 sec counting time. Keep the minimum output frequency above the 10 kHz low-frequency cutoff, preferably above 100 kHz to avoid effect of wideband noise on counter.

The above checks serve the primary function of assuring that the signal paths from the digit oscillators to the output section are functioning properly, over the entire frequency range. (In Remote Only option instruments, frequency programming by external means must be used for these checks).

5.5.4 Output Amplitude.

The amplitude variations, from the lowest indication to the highest, must be less than 1.2 dB from 10 kHz to 500 MHz.

Use the following procedure to check the output amplitude response:

a. Set the synthesizer output frequency to 50 MHz.

b. Connect the 1806-P1 Probe and the GR874-W50BL 50 Ω termination to the 1806-P1 Tee.

c. Connect the GR 1806-P1 Tee and 1806-P1 probe to the OUTPUT connector of the synthesizer.

d. Adjust the synthesizer OUTPUT LEVEL control (or external level program voltage) for an indication of 1.0 V on the 1806 Voltmeter.

e. Vary the synthesizer output frequency from 10 kHz to 50 MHz and note that the response, as indicated by the 1806 Voltmeter, varies no more than 6%.

f. Connect HP432A/478A with GR 874–G10 to output.

g. Level should be within 0.6 dB of +13 dBm, from 50 to 500 MHz.

5.5.5 Spurious Frequency Outputs.

Connect a spectrum analyzer to the OUTPUT connector of the synthesizer.

a. Set the synthesizer dials to the desired frequency and adjust the OUTPUT level control for maximum output.

b. Check the analyzer for nonharmonic and harmonic spurious signals. Harmonic (at maximum output with 50 Ω load): 0.01 to 500 MHz $<$ 25 dB. Discrete nonharmonic: 0.01 to 500 MHz $<$ 80 dB.

5.5.6 Phase and Amplitude Noise Modulation.

Phase-noise modulation is not critically dependent on the output frequency. It can be measured by using the rear-panel 10 MHz OUT signal to check the synthesized output at 10 MHz. Figure 5-5 shows the recommended setup for measuring both phase and amplitude noise modulation of the synthesizer OUTPUT. The HP 10514-A Double-Balanced Mixer output must be fed through a 15-kHz low-pass filter (Figure 5-4) to comply with specifications. The shielded ±3-V battery and potentiometer, feeding the rear-panel PHASE MOD input, permits relative phase adjustment of the output and reference sources. The noise meter must have sufficient sensitivity to measure at least 65 dB down from the calibrate level, which is approximately 250 mV in the setup shown.

For minimum effects from stray capacitance and magnetic fields, the filter circuit and the battery-potentiometer circuit (shown in Figure 5-5) should be mounted in shielded enclosures. The GR 874-X Insertion Unit (P/N 0874-9990) is recommended as a convenient mounting device for the former and the GR 874-ML Component Mount (P/N 0874-9663) is suitable for the latter. Mount the 1-kΩ

potentiometer (R1) inside the component mount so that the adjustment screw aligns with one of the holes in the mount cover. The J.F.D. Adjustment Tool number 5284, is a convenient tool for adjusting R1.

Make the connections as shown in Figure 5-5. To calibrate the phase- and amplitude-noise modulation measuring system, set the frequency dials to read 10,001,000 Hz† and adjust the OUTPUT level control to produce a convenient reference indication on the noise meter, such as −10 dB.

To measure the phase-noise modulation follow this procedure:

a. Set the frequency dials to 10,000,000 Hz.

b. Set SW1 (Figure 5-5) to the closed position.

NOTE

Set SW1 to the off position when not in use.

c. Adjust R1 (Figure 5-5) for 0-V dc out of the mixer.

d. Increase the noise-meter sensitivity until an indication of phase-noise modulation is obtained. It should be at least −60 dB.

To measure the Amplitude-Noise Modulation follow this procedure:

a. Perform the calibration procedure above.

b. Set the frequency dials to 10,000,000 Hz.

c. Set SW1 (Figure 5-5) to the closed position.

d. Adjust the battery potentiometer for maximum dc out of the mixer.

e. Remove the 1806 – this eliminates possible effects on the amplitude-noise modulation measurement.

f. Observe the amplitude-noise modulation on the noise meter to be at least −75 dB.

5.6 TROUBLE ANALYSIS.

5.6.1 General.

Sectional construction of the unit simplifies trouble analysis and repair. Most circuits are divided, both functionally and physically, among up to 25 plug-in etched-circuit boards; 15 of them plug into single-board shielded enclosures, and up to 10 of them plug into the fine-resolution section. Most enclosure covers are forced on or off with 2 captive screws, providing easy access to the etched boards. Trouble analysis to the etched-board level only is recommended.

Detailed block diagrams (Figures 6-4 and 6-5) provide nominal power-supply voltages, signal frequencies and signal levels. This information should be used in conjunction with the schematic diagrams as an aid for locating a malfunction.

The 50-Ω load termination, specified for many of the signal levels, is not mandatory for general signal tracing with a high-impedance probe. However, a 50-Ω load must be provided where specified for final testing or calibration.

Performance of the tests described in para. 5.5 will in many cases suggest to a user, thoroughly familiar with synthesizer operation, where a malfunction is originating. If no output signal is present, it is necessary to perform other tests to locate the problem. A logical starting point is the power supply. See also para. 5.11.

5.6.2 Trouble-Analysis Procedures.

If the synthesizer output is abnormal or if no output is present, use the following procedures (in the order presented) to isolate the problem.

Power Supply. Three rear-panel pin jacks provide a means of checking power-supply voltages. If any of them are absent, first check the wiring between the rear-panel socket and the power supply. Once a malfunction is isolated to the power supply, systematically check the levels listed on Figure 6-32 and in Table 5.2.

A component replacement, in most cases, will not require readjustment of the supplies. However, an adjustment procedure is included for use where necessary.

Use the following procedure to check or adjust the power-supply voltages:

NOTE

Do not adjust these voltages unless absolutely necessary.

a. Use the John Fluke Differential DC Voltmeter Model 825A or equivalent. Set the controls as follows:

RANGE control	– – – 50
Null control	– – – 0.1
Input control	– – – (–)
A-E controls	– – – 12.000

b. Connect the −12 V pin jack to the differential dc voltmeter input. Use a multimeter test lead and insert the probe into the pin jack.

c. Connect the synthesizer chassis to the differential voltmeter ground terminal. The ground terminal shorting bar should be connected to the low input terminal.

d. Check or adjust the −12 V supply to be within 0.02 V as indicated by the Fluke 825-A. Coarse and fine controls are provided for ease of setting.

NOTE

Step d must be executed before step e.

e. Repeat step d for the +18 ±.02 V and +5.6 ±.02 V supplies.

Master Oscillator. Connect the 454 scope to the rear-panel 10-MHz jack. This signal comes from the master oscillator unit via sections RP and RB. If no signal is present at the rear-panel jack, remove the RBA board and check for a signal at terminal 5. If no signal there, remove

†10,010 kHz may be used on minimum-resolution option instruments.

the RPA board and check for a signal at terminal 18. Frequency accuracy is not important at this point. Look for the absence (or presence) of the signal, or for a frequency that is significantly different from 10 MHz.

With external drive, check the output signal of the drive source.

Other Modules. With no clue to the problem at this juncture, an assumption can be made that the malfunction is in one of the other modules. A recommended procedure is to check the outputs and inputs of each module starting with section OA and working back toward the digit oscillators. Use the 1806 electonic voltmeter, with an ac probe and a short ground lead, to measure the levels; use the 454 scope with the P6047 probe to measure frequency up to 150 MHz. Above this frequency use a counter or a scope with a higher frequency limit.

Figures 6-4 and 6-5 list the levels as dBm into a 50-Ω load, however, for convenience the termination can be eliminated when troubleshooting. This will allow the measurements to vary as much as 3 to 1, but the detection of the presence or absence of a level is all that is necessary to isolate the problem to a particular board.

NOTE

Matched boards are used in sections EW–EX and GK – GL. If a board from any of these sections has to be returned for repair, return both boards for the particular section involved. Refer to para. 5.4.1 and/or the parts list for part numbers.

5.7 OUTPUT ADJUSTMENTS.

5.7.1 General.

The trouble-analysis procedure could result in the replacement of one or more etched-circuit boards. If that is the case, the adjustment procedures presented in this para. should be checked to insure proper operation.

5.7.2 Master Oscillator Frequency.

The master oscillator must be adjusted periodically, to correct for normal crystal aging. A rear-panel screwdriver adjustment is provided for that purpose on the high stability oscillator.

NOTE

Before attempting to make this adjustment, allow the master oscillator to operate for a minimum of 2 hours.

Use the following procedure to adjust the master-oscillator frequency:

a. Connect the 1115-C 5-MHz output to the Tektronix Model 454 oscilloscope EXT TRIG. Use the GR 776-B patch cord.

b. Set the scope controls as follows:

"A" TRIGGER (source) – – – – EXT
TIME/DIV – – – – – – – – – – 0.05 μs
MODE TRIGGER – – – – – – – CH1
HORIZ DISPLAY (mag) – – – – X10
"A" SWEEP LENGTH – – – – – FULL
VOLTS/DIV (CH1) – – – – – – 1 V

c. Set the frequency dials to 100,000,000 Hz.

d. Set the OUTPUT control to 1 V.

e. Connect the OUTPUT to the scope CH1 INPUT.

f. A 100-MHz sinewave pattern will appear on the CRT and two divisions of the graticule will represent one complete cycle. Using an insulated screwdriver (such as the GC 8290)* adjust the master-oscillator frequency control until the sinewave pattern stops moving or slows to a rate of less than 2 div/sec. The master oscillator frequency is now set to an accuracy $\geq 1 \times 10^{-8}$.

The moderate stability master oscillator is adjusted from the top of the instrument so it must be removed from the cabinet for this adjustment. The oscillator can be adjusted in a manner similar to that for the high stability oscillator except setting to within 1×10^{-7} is adequate and this can be done by observing a 10 MHz output on a .05 μs/division display and adjusting for less than 2 div/sec drift.

5.7.3 Output Level Control.

Use the following procedure to calibrate the OUTPUT level control:

a. Adjust R5 for 1-V r-f output with control set to +13 dBm. Adjust R6 for 0.1 V with control set to –7 dBm. These controls are accessible from the bottom of instrument.

b. Check the +7 dBm position at 0.5 V output to be within ±1 dB. If any of these output control settings exceed specifications, remove the control knob and slip the bushing to compensate for the discrepancy. Replace the knob and recheck the same positions.

c. Set the output control to the +13 dBm position. Vary the synthesizer output frequency from 10 kHz to 500 MHz and observe the response as indicated by the voltmeter. Variations from the lowest indication to the highest must be less than 1.2 dB.

5.8 AUXILIARY OUTPUTS.

Two auxiliary fixed-frequency outputs are available from separate rear-panel BNC jacks. One is a 1-MHz square-wave signal of 2-V pk-pk, into 10-kΩ; the other is a 10-MHz sinusoid signal of 0.5 ±0.05 V rms, into 50 Ω.

The rear-panel power supply test points can also be used as auxiliary voltage outputs; do not exceed 50 mA loads.

*General Cement or equivalent.

Table 5-1
TEST EQUIPMENT

Function	Recommended Type or Model*	Performance Characteristics
Frequency programming switch	Type 378 DIGISWITCH, ♦ 10 station	BCD contact closures to ground to exercise decade steps via A-J8.
Electronic Voltmeter (VTVM) Rf Voltmeter AC Voltmeter	GR 1806 (with 1806-P1) HP-411 or HP-3406 HP-403-A	1.5 – 1500 V full scale, ±2% accuracy +20 dBm to –30 dBm –10 kHz to 1 GHz. 100 μV - 300 V, dB range - 60 to 50 dB
Dc Differential Voltmeter	John Fluke 825-A	0-500 V accuracy ±0.02% +25 μV below 0.1 V
Power Meter	HP432 (with 478A)	–20 to +10 dBm F.S., ±1%
VOM	Triplet 630 NA	Dc accuracy ±2%
Metered Variac®	GRW5MT3W	300 W/150 V, full scale, meters
Oscilloscope	Tektronix† 454	Dc to 150 MHz (with P6047 probe).
Counter, High Frequency	Systron - Donner 6057	20 Hz to 18 GHz
Counter with Scaler	GR 1191/Z	Dc to 500 MHz
Spectrum Analyzer	HP 141T/8552B 8553 /8554	1 kHz - 1.2 GHz
Double Balanced Mixer	HP 10514-A	"L" and "R" ports: 200 kHz to 500 MHz "X" port: dc to 500 MHz
Frequency Standard	GR 1115-C	Output Frequencies: 5MHz, 1 MHz, and 100 kHz
Patch cord	GR 766-C (2)	BNC plug to BNC, 3 ft.
Patch cord	GR 776-B (2)	GR 874 to BNC, 3 ft.
Patch cord	GR 874-R22LA	GR874 connector, 3 ft.
Coaxial Tee	GR 874-TL	Locking version
Coaxial Load	GR W50BL	50 Ω ±0.5%
Coaxial Pad	GR 874-G10L	50 Ω 10 ±0.15 dB
Insertion Unit	GR 874-X	2 in. long, 9/16-in. dia.
Component Mount	GR 874-ML	2 5/8-in. long, 3-in. dia.
Coaxial Adaptor	GR 874-QMMP	SMA Jack to GR874®
Coaxial Adaptor	GR 874-QNPL	Type-N Jack to GR874
RFVM Tee	HP 11063A	Use with RF Voltmeters

*Or equivalent

♦Digitran Co., 855 S. Arroyo Pkwy., Pasadena, CA.

†Reg. trademark, Tektronix Inc., Beaverton, Ore.

5.9 PREVENTIVE MAINTENANCE

5.9.1 Cleaning the Exterior.

Loose dust accumulating on the outside of the instrument can be removed with a lint-free cloth or a small paint brush. A paint brush is particularly useful for dislodging dust on and around the front-panel controls. A soft cloth, dampened with water and a small amount of keolite, can be used to remove a harder coating of dirt. Abrasive cleansers should not be used.

5.9.2 Cleaning the Interior.

Dust that penetrates the interior of the instrument should be removed at regular maintenance periods, since a heavy accumulation of dust can cause the instrument to overheat. Since some internal adjustments might be disturbed, it is suggested that the instrument interior be cleaned before recalibration.

Perhaps the best way to clean the interior of the instrument is to blow off dust using low-velocity compressed air. To prevent damage to components, avoid a high-velocity air stream. Persistent dirt can be removed using a damp cloth or a small paint brush. A cotton-tipped applicator, dampened with alcohol, can be used for cleaning in narrow spaces.

5.9.3 Visual Inspection.

Many potential and existent troubles can be detected by a visual inspection of the instrument. For this reason, you should perform a complete visual check every time the instrument is calibrated or repaired and during other routine maintenance work.

Defects that may be detected visually include such things as loose or broken connections, loose set screws in knobs, loose or damaged connectors, improperly seated devices, and scorched or burned parts. The remedy for most of these troubles is apparent. However, particular care must be taken when heat-damaged components are detected. Overheating of parts is often the result of other, less apparent, defects in the circuit. It is essential that you determine the cause of overheating before replacing heat-damaged parts, in order to prevent further damage.

Diagrams detailing internal cabling appear in Figure 5-6 through 5-9.

5.10 LUBRICATION

The only parts on the instrument requiring lubrication are the digit-selector switches, found only on instruments with the front-panel control option, OP1. These switches are lubricated at the factory and should require no further lubrication.

The only assemblies requiring mechanical alignment are the dials related to the above-mentioned switches, and the alignment details are given in para. 5.4.7.

Table 5-2

DC VOLTAGES IN POWER SUPPLY*

Device	Pin	Voltage	Voltage	Device	Pin	Voltage
Q1	E	–0.6	–.6	Q9	E	0.66
	B	1.0	.04		B	17.4
	C	17.6	17.4		C	18.0
Q3	E	17.4		Q10	E	–0.02
	B	17.6			B	0.5
	C	0.5			C	20.5
Q4	E	–0.05		Q11	E	19.8
	B	0.46			B	20.5
	C	8.0			C	33.8
Q5	E	7.3		Q12	S	21.0
	B	8.0			G	20.5
	C	10.6			D	33.8
Q6	S	8.2		Q13	E	18.0
	G	8.0			B	17.8
	D	17.6			C	20.5
Q7	E	–0.5	–.5	Q14	E	0.02
	B	–0.1	–.01		B	0.16
	C	18.0	17.4		C	2.8
U1	1	1.5			6	.6
	2	12.0			7	.03
	3	9.3			8	–8.6
	4	2.8			9	.02
	5	0				
Heat-Sink Assembly						
Q1	E	6.6		Q3	E	19.4
	B	7.3			B	19.8
	C	10.6			C	24.2
Q2	E	0.8		Q4	E	19.9
	B	1.4			B	19.4
	C	4.8			C	24.2

*Voltages taken with reference to chassis ground.

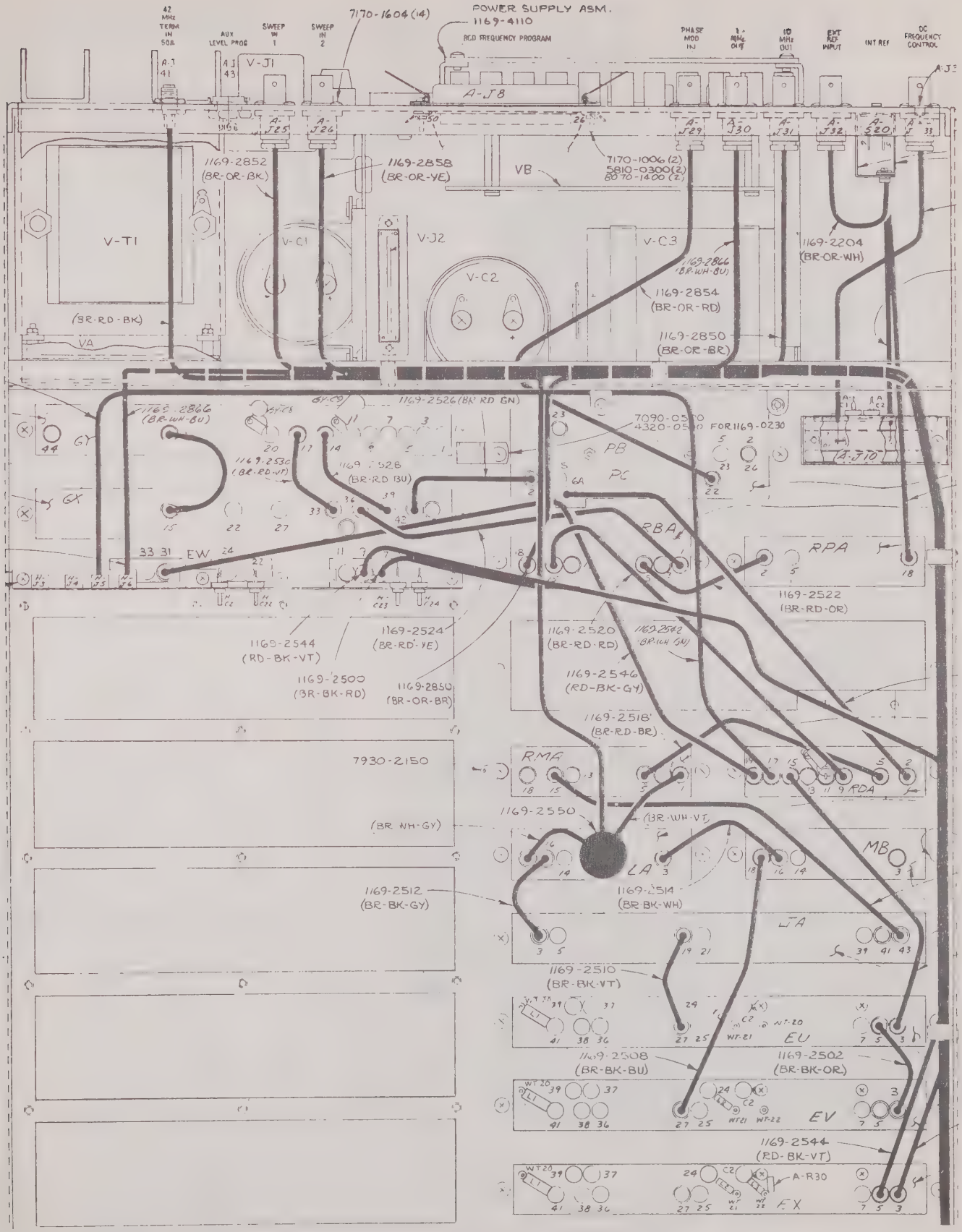


Figure 5-6. Rigid r-f coaxial cabling detail, bottom view of chassis, with microwave and UHF Sections removed. See also Figure 5-7.

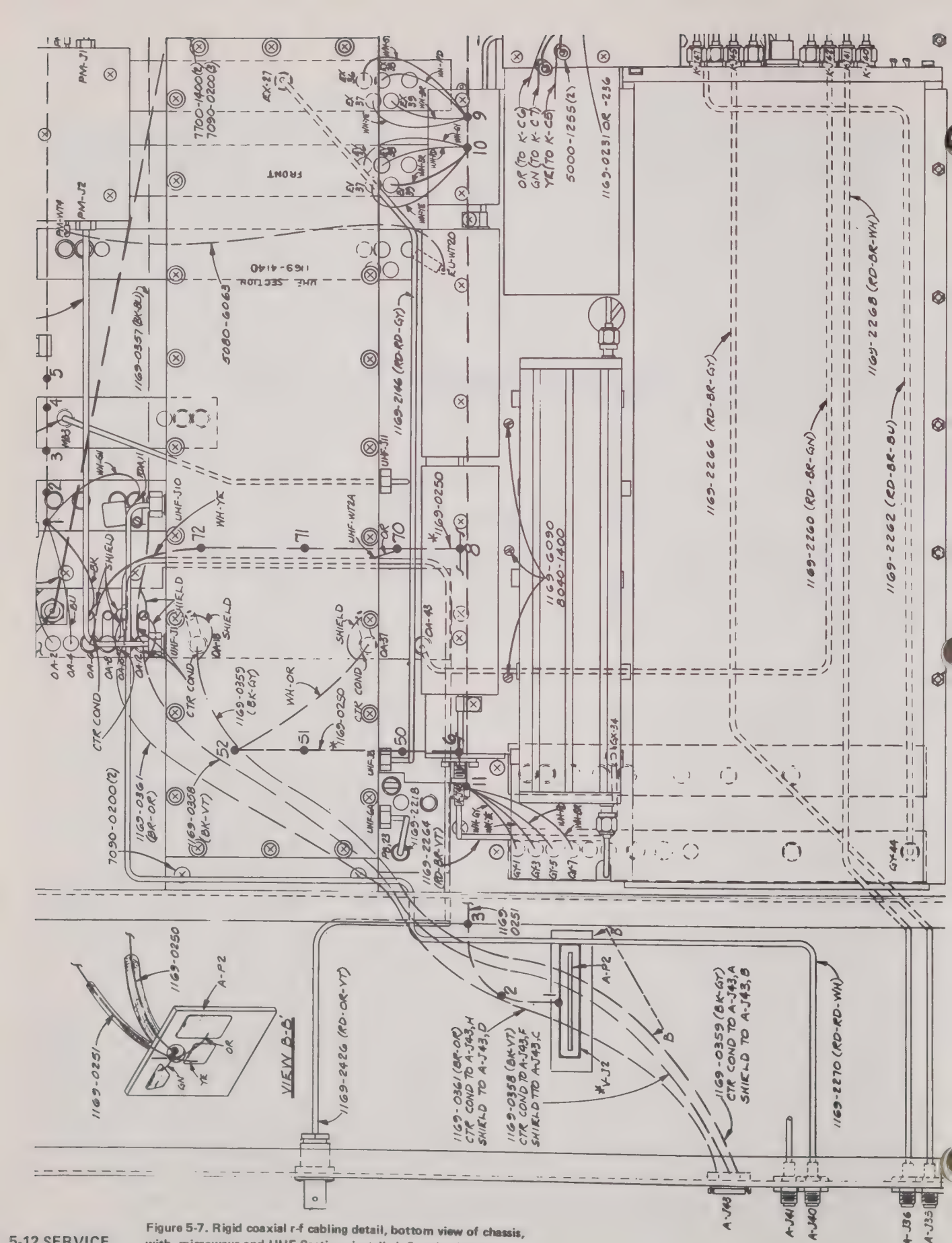


Figure 5-7. Rigid coaxial r-f cabling detail, bottom view of chassis, with, microwave and UHF Sections installed. See also Figure 5-6.

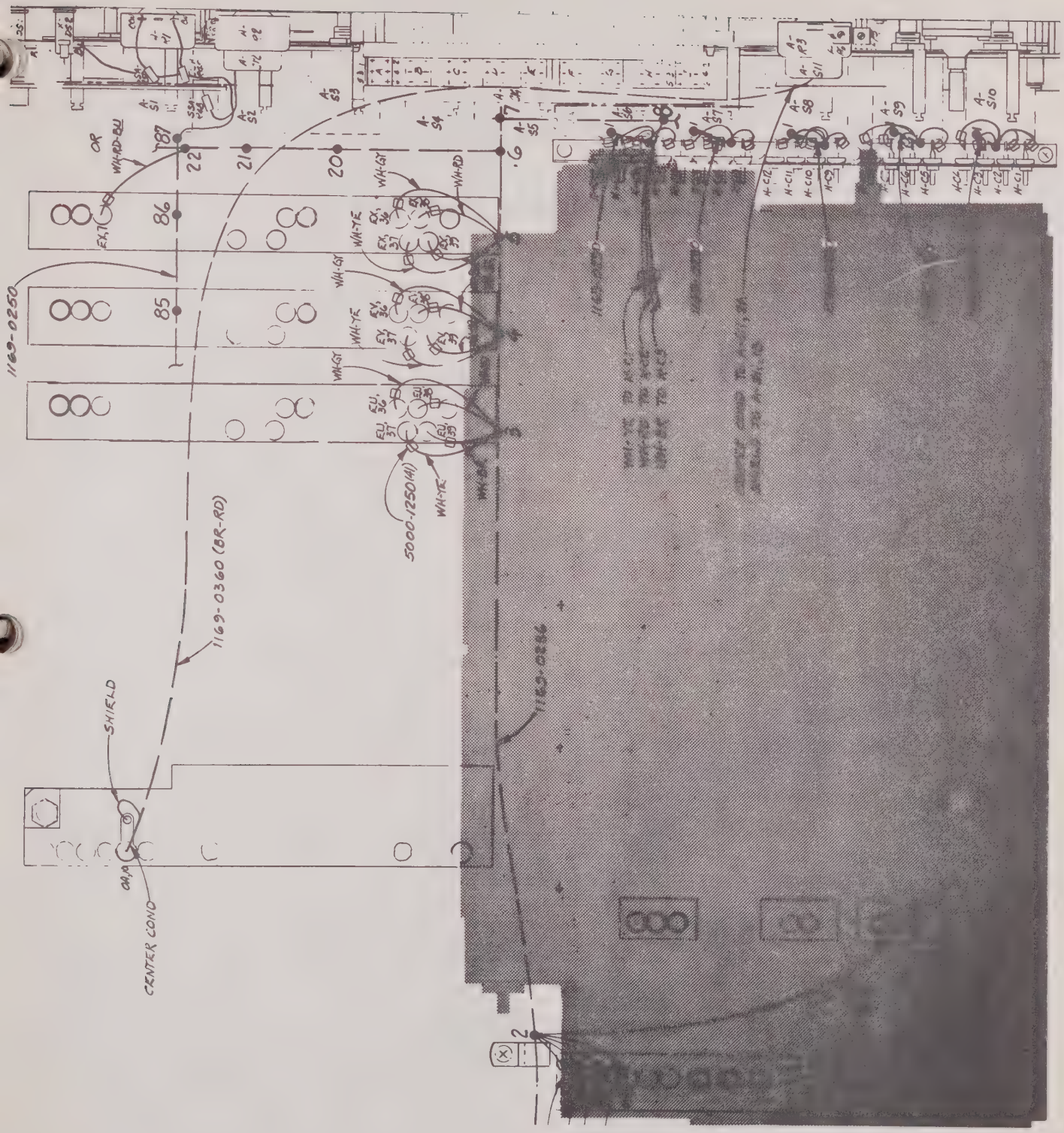


Figure 5-8. Internal flexible cable details — with control panel in place.

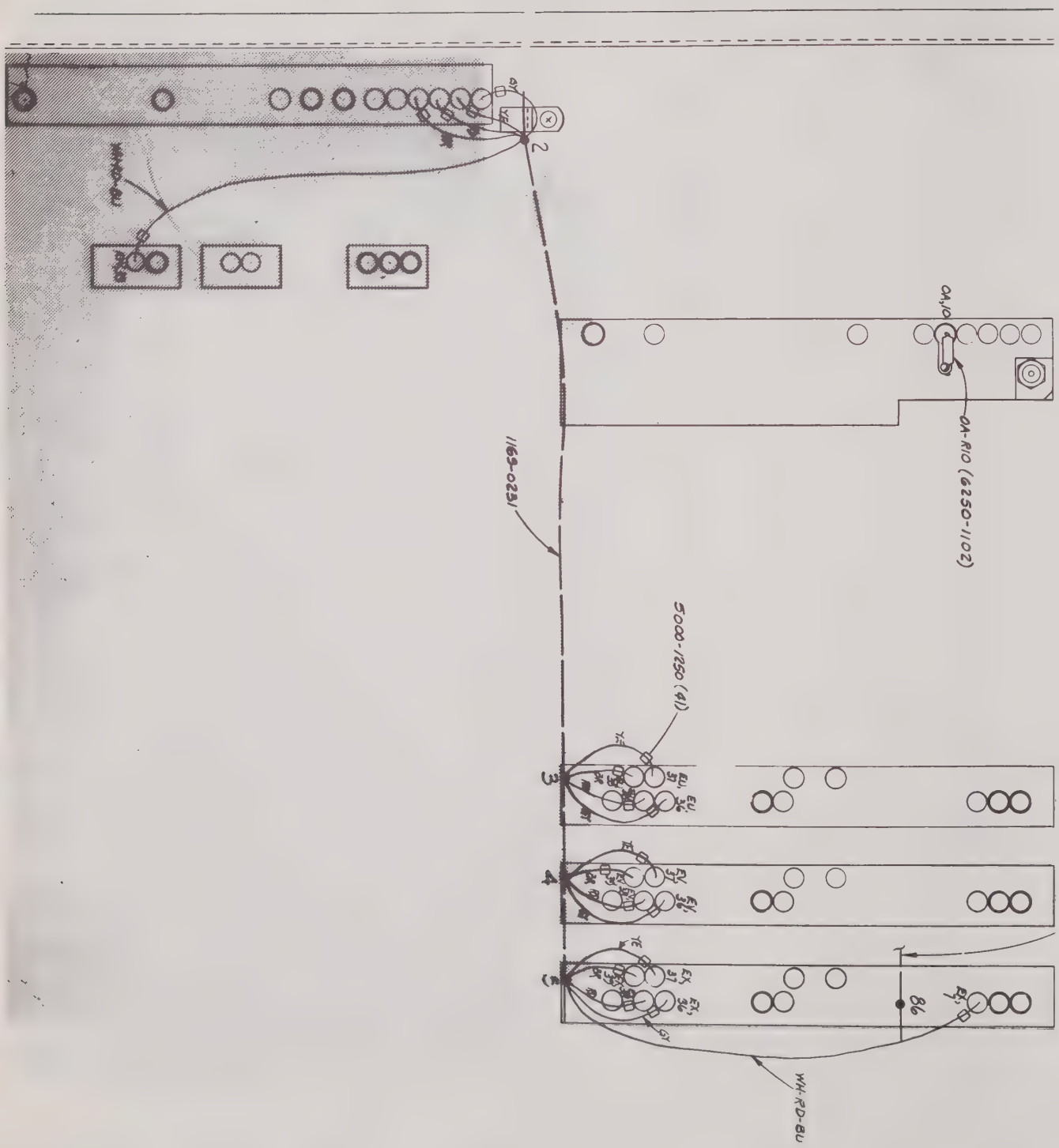


Figure 5-9. Internal flexible cable details — option with no control panel.

5.11 DETAILED TROUBLE ANALYSIS.

5.11.1 General.

For users equipped with the special synthesizer repair kit (P/N 1169-9000), it is possible to perform detailed trouble analysis, beyond the indications given in para. 5.6, to determine which specific board has failed. Procedures are given in Charts I through IV in this section. Typical signal levels are shown on Figures 6-4 and 6-5 and in Table 5-4.

5.11.2 Special Test Equipment.

In order to preserve signal purity, synthesizer circuitry has to be rigorously isolated by fairly extensive and complex r-f shielding. Thus, circuits are enclosed in metal-shield structures and signal paths between them are constructed of rigid-walled coaxial cables, terminated with locking coaxial connectors. Add to this the constraints of cabinetry consistent with miniature circuitry, and you have a situation that makes access to test points on active signal paths somewhat difficult. Further, there is great likelihood of accidental short circuit.

The repair kit should simplify the process of probing internal test points in the synthesizer and thereby speed the procedures needed to isolate board failure.

The kit consists of a set of extender boards that bring out the pin connections on the central interconnect structure of the instrument, by means of which individual circuit boards interface the rest of the unit. The cards elevate the interconnect points, to permit them to function as test points, at which several test instruments can be connected simultaneously, to evaluate signal quality.

Since many of the signals must be specified in terms of 50-ohm transmission line, the test points are extended in broad strip-line paths of the appropriate dimension to retain the 50-ohm impedance.

The extender cards can also be used to mount the circuit board, outside its shield enclosure, for detailed probing on the board itself, as required.

CAUTION

Extender cards are not keyed, to prevent improper orientation of circuit boards mounted in them. Reversed mounting could result in circuit-board damage.

The extender cards come in a set that covers standard 19-, 27- and 45-pin configurations of pluggable circuit board found in the synthesizer, plus special cards for boards that have shield enclosures mounted on them that interfere with the connectors on the standard extender cards. The cards are shown in Figure 5-10.

Access to the extended test points is usually accomplished by means of an SMA coaxial jack assembly that plugs into the multipin connector on the top of the card, to furnish a coaxial connection point (in 50 ohms) at which to join the external test equipment set-up, such as shown in Figure 5-11.

A final item of special test equipment, which can be fabricated from commercially available parts, is a short probe for rapid signal tracing among pins inside the circuit-board-enclosure bases, with board removed. It is useful only to determine the presence or absence of a signal and cannot be used for measurements.

The probe consists of a 6-in. length of 3-mm rigid-walled coaxial cable with about 1/4-in. of center conductor exposed on one end and an SMA plug connector mounted on the other. The connector can be Amphenol P/N 903-113 and the cable can be 0.141-in. diameter "Cujak".

The probe can be connected to the test set-up in Figure 5-11 by means of a GR 874-QMMJ Adaptor and a GR 874-R22A Patch Cord. Ground connection can be established by touching the outer conductor of the probe to any nearby shield enclosure in the synthesizer.

5.11.3 Special Disassembly Tools. Figure 5-10

Signal paths inside the synthesizer are carried in .086-in. O.D. coaxial cable of the rigid-walled variety, for the most part. Connector junctions along this path take one of two forms. Those with locking nuts that have a gold finish are standard SMA plug/jack pairs and can be released with a standard 5/16-in. open-end wrench. The majority, however have fluted white-metal nuts. These fluted nuts retain the outer conductors of the cables in bulkhead-mounted bushings. The inner conductors plug into jacks in the case of the UHF and PM assemblies but are soldered into clips in the enclosure-base assemblies for other modules.

Included with the repair kit (P/N 1169-9000) is a set of wrenches that are specially constructed to facilitate disconnection of these coaxial junctions. The wrenches are fitted with lugs that grip notches in the retainer bushing, with adequate clearance to straddle the cable.

One tool, a modified flat-bladed screw-driver, is for use on coaxial junctions in the bottom side of the enclosure-base assemblies. The other is a double-ended open-end wrench for use on wall-mounted connectors, such as found on the UHF Assembly.

5.11.4 Procedures.

The detailed trouble-analysis procedures that should be followed are given in Charts I through IV in this section. In general, they trace back from the external connector for the main output of the synthesizer through the coarse-resolution, to the UHF section, and, finally, through the fine-resolution sections to the primary reference source. In addition, detailed power-supply trouble analysis is presented.

The charts call for sequential signal probing of connectors inside the enclosure bases for signal-chain circuits, on a board-by-board basis. In each instance, the shield enclosure for the board must be removed, the circuit board itself

Table 5-3
EXTENDER BOARD USAGE
CROSS-INDEX BY CIRCUIT BOARD PART NO.

Circuit Board Part No.	Extend. Board Part No.	Schematic Page No.	Circuit Board Part No.	Extend. Board Part No.	Schematic Page
1165-4018	1169-4874	6-27	1169-4048	1169-4871	6-41
1165-4022	1169-4872	6-49	1169-4052	1169-4873	6-33
1169-4000	1169-4874	6-45	1169-4053	1169-4873	6-19
1169-4006	1169-4871	6-43	1169-4060	1169-4875	6-25
1169-4008	1169-4872	6-37	1169-4062	1169-4871	6-29
1169-4010	1169-4873	6-21	1169-4065	1169-4875	6-25
1169-4044	1169-4873	6-11	1169-4094	1169-4873	6-15
1169-4046	1169-4874	6-47	1169-4096	1169-4873	6-17

All other circuit boards are non-extendible

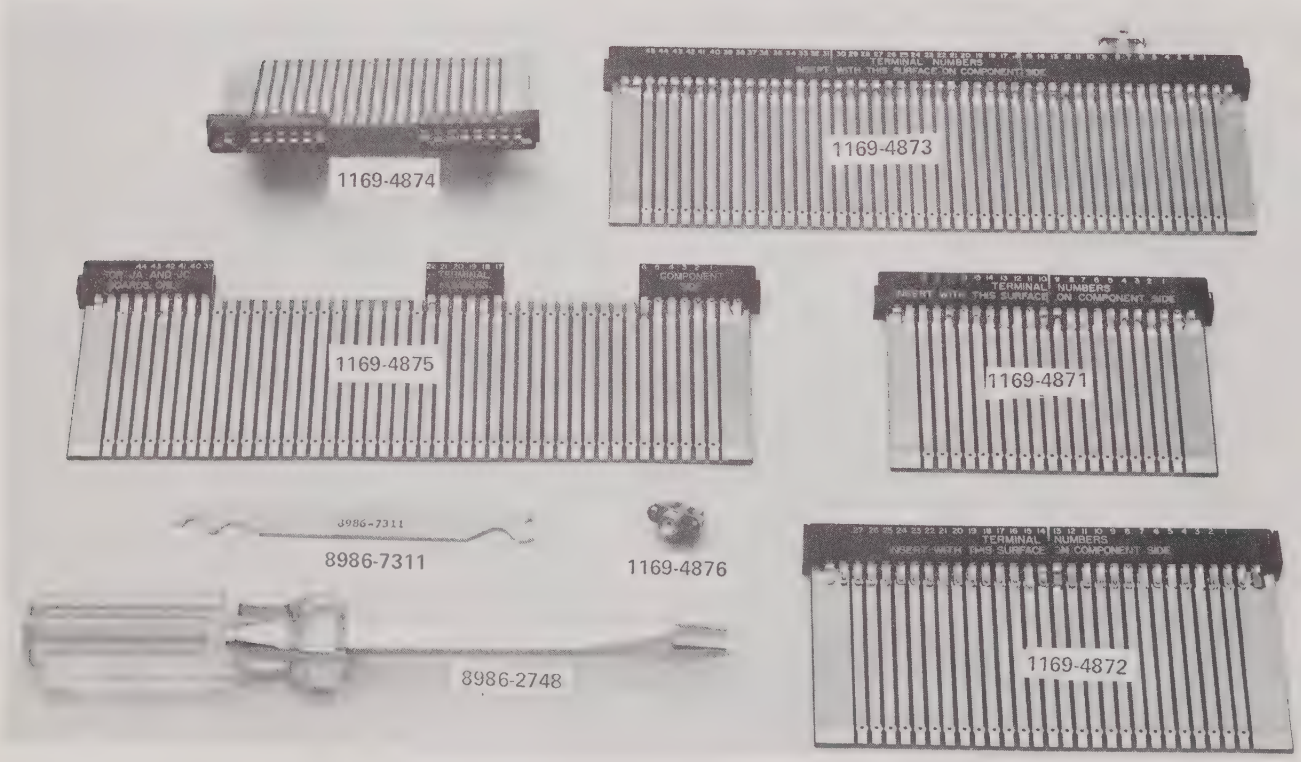


Figure 5-10. Kit for detailed trouble analysis inside synthesizer.

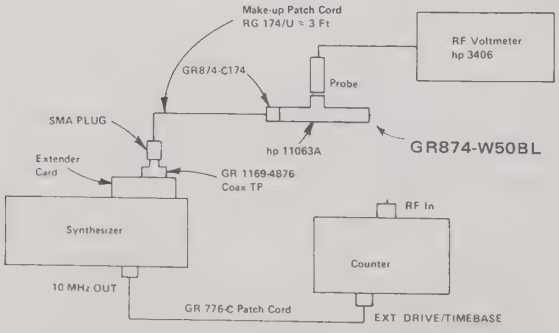


Figure 5-11. Test set-up for use with trouble charts for measurements in 50 ohms.

removed, and the appropriate extender card inserted in its place. In only one instance does the circuit board have to be mounted in the extender card.

In the event that the procedures indicate that a particular board has failed, it should be replaced. On the other hand, if the board proves out satisfactorily, it should be reinstalled and its enclosure should be remounted, before further probing is undertaken.

CAUTION

Tuned circuits on the boards interact with the shield enclosures, precluding effective field changes or adjustments.

5.11.5 Spurious-Signal Levels.

If the procedures of para. 5.5.5 indicate excessive spurious-frequency components in the output, it is possible to trace back down the signal path, as in para 5.11.4, and pick up the circuit board where the spurious frequency first enters the signal chain, which could indicate either a defective board or a failure in shielding, permitting a leakage path at that location.

To isolate such a malfunction, substitute the spectrum analyzer for the r-f voltmeter in the test set-up in Figure 5-11 and utilize the extender cards. Typical values of spurious frequencies at likely points along the signal chain are given in Table 5-5.

5.12 INTERNAL DISASSEMBLY PROCEDURES.

5.12.1 General.

The necessarily rigorous r-f shielding inside the synthesizer calls for more than ordinary care in original assembly at the factory. If shield enclosures are removed, or high-frequency assemblies opened, they must be put back tightly in the same arrangement. Otherwise, internal leakage paths could occur that would result in serious deterioration of output signal purity. Figures 5-6 through 5-9 show physical details.

5.12.2 Output Amplifier Considerations.

If the board in the Output Amplifier section must be replaced it will be necessary to remove the SMA connector that is located directly under the Output Amplifier section. The connector is accessible from the exterior bottom surface only (refer to para. 5.4.2).

5.12.3 UHF Assembly.

Solder-connected circuit boards in the UHF Assembly can be replaced if found to be defective.

Replacement of the following boards can be accomplished without disconnection of the r-f cables or removal of the assembly from the chassis. They can be accessed directly after removal of the cover plate.

They are:

500-MHz Low-Pass Filter Output	1169-1000
Amplifier (470 MHz)	1169-4026
Mixer (510-MHz Output)	1169-4095
Amplifier (510-MHz)	1169-4030
Mixer (470-MHz Output)	1169-4098
Amplifier (50 MHz)	1169-4036

A compressible lead-loaded plastic cord, lying in grooves in the tops of interior walls of the assembly, completes the r-f shielding between the cast-metal compartments. The cords must be in place and should just touch at junctions.

CAUTION

The UHF Assembly should lie flat on a horizontal surface when covers are removed, so that the compressible shields can't fall out.

5.12.4 Coaxial Connectors.

Disassembly of the interior coaxial-connector junctions is described in para. 5.11.3. The rigid-walled coaxial cables have sufficient flexure to allow removal of any assembly to which they are attached. However, the shorter the cable the less the flexure.

5.13 MICROWAVE ASSEMBLY ADJUSTMENTS. (Figure 6-32)

When a replacement assembly (P/N 1169-4180) is installed the following adjustments might have to be touched up. The assembly is factory calibrated; check instrument performance before making any adjustment.

NOTE

Allow 1 hour warmup

Proceed as follows.

a. Install the Microwave Assembly in the chassis.

b. Connect the high-frequency counter to the 1.8-2.2-GHz jack (A-J35) at the rear panel and adjust the 100-MHz step-programming frequencies to within ±0.5 MHz. The secondary adjustments below set the frequency; vary the 100-MHz dial to produce the primary frequencies.

Dial	Frequency Adjustments	
0	F0	1770
1	F1	1870
2	F2	1970
3	F3	2070
4	F4	2170

c. Remove the counter from the 1.8- to 2.2-GHz jack and connect the HP432 powermeter. Step through the 100-MHz dial and observe that the output level is between −0.5 and +4 dBm.

d. Remove the r-f lead from the output of the 1965-1975 MHz Interdigital Bandpass Filter (lead is at the rear connection to the filter).

e. Connect the power-meter to the filter output jack. Measure the output of the filter to be between −.7 and +2.0 dBm. The level at the output of the filter can be adjusted with R5 and C11 on the 100-200 MHz Output Board (P/N 1169-4084) when the 100-MHz dial is set to 0, 1, 3 and 4. R5 and R6 on the +13 V Regulator board (P/N 1169-4088) can be adjusted when the dial is set to 2. Reconnect the r-f lead on the filter when adjustments are complete.

TROUBLE ANALYSIS CHART I
COARSE RESOLUTION SECTIONS

Test Set-up Fig. 5-11

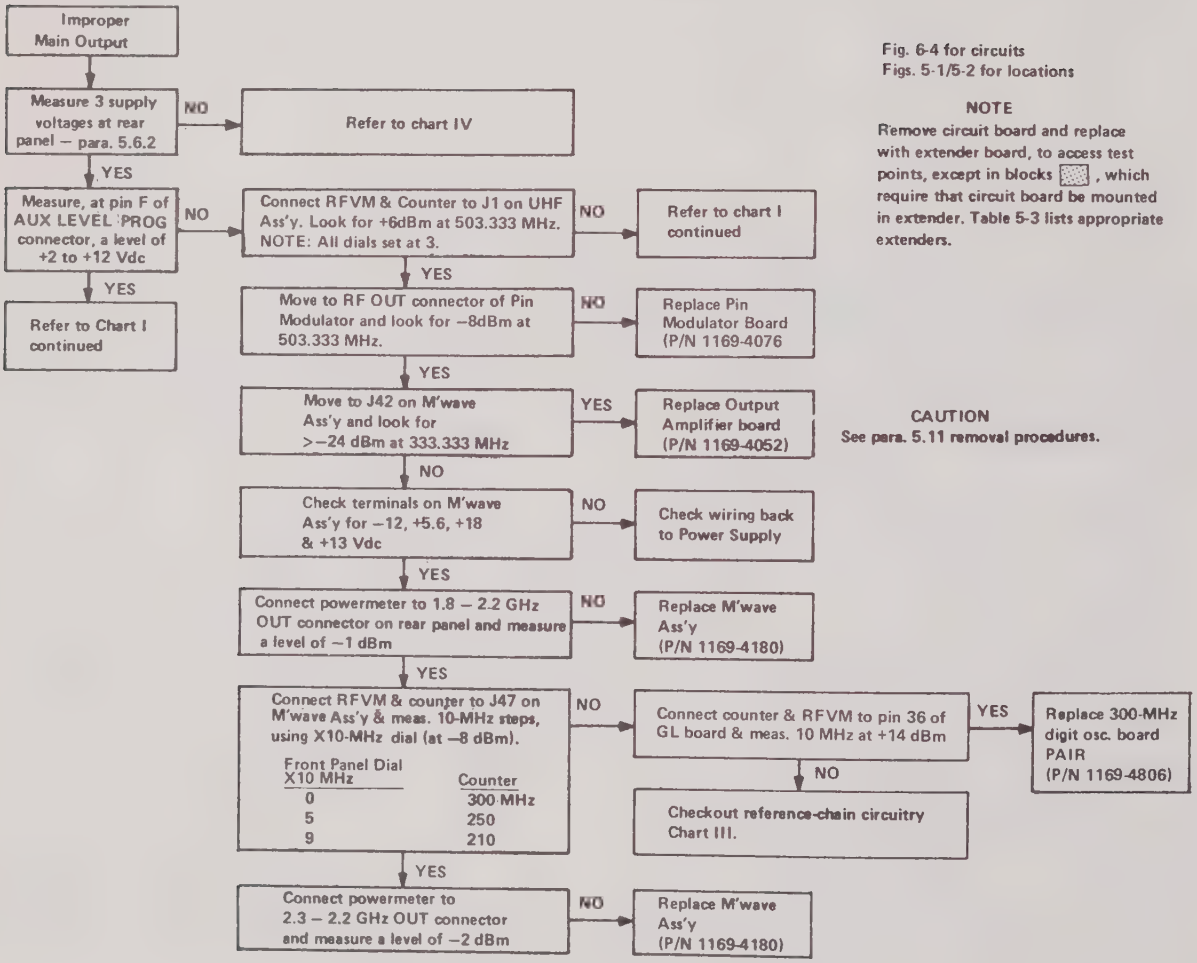

Improper Main Output
Measure 3 supply voltages at rear panel – para. 5.6.2
NO
Refer to chart IV
YES
Measure, at pin F of AUX LEVEL PROG connector, a level of +2 to +12 Vdc
NO
Connect RFVM & Counter to J1 on UHF Ass'y. Look for +6dBm at 503.333 MHz. NOTE: All dials set at 3.
NO
Refer to chart I continued
YES
Refer to Chart I continued
YES
Move to RF OUT connector of Pin Modulator and look for –8dBm at 503.333 MHz.
NO
Replace Pin Modulator Board (P/N 1169-4076
YES
Move to J42 on M'wave Ass'y and look for >–24 dBm at 333.333 MHz
YES
Replace Output Amplifier board (P/N 1169-4052)
NO
Check terminals on M'wave Ass'y for –12, +5.6, +18 & +13 Vdc
NO
Check wiring back to Power Supply
YES
Connect powermeter to 1.8 – 2.2 GHz OUT connector on rear panel and measure a level of –1 dBm
NO
Replace M'wave Ass'y (P/N 1169-4180)
YES
Connect RFVM & counter to J47 on M'wave Ass'y & meas. 10-MHz steps, using X10-MHz dial (at –8 dBm).
Front Panel Dial X10 MHz
Counter
0
300 MHz
5
250
9
210
NO
Connect counter & RFVM to pin 36 of GL board & meas. 10 MHz at +14 dBm
YES
Replace 300-MHz digit osc. board PAIR (P/N 1169-4806)
NO
Checkout reference-chain circuitry Chart III.
YES
Connect powermeter to 2.3 – 2.2 GHz OUT connector and measure a level of –2 dBm
NO
Replace M'wave Ass'y (P/N 1169-4180)

Fig. 6-4 for circuits
Figs. 5-1/5-2 for locations

NOTE

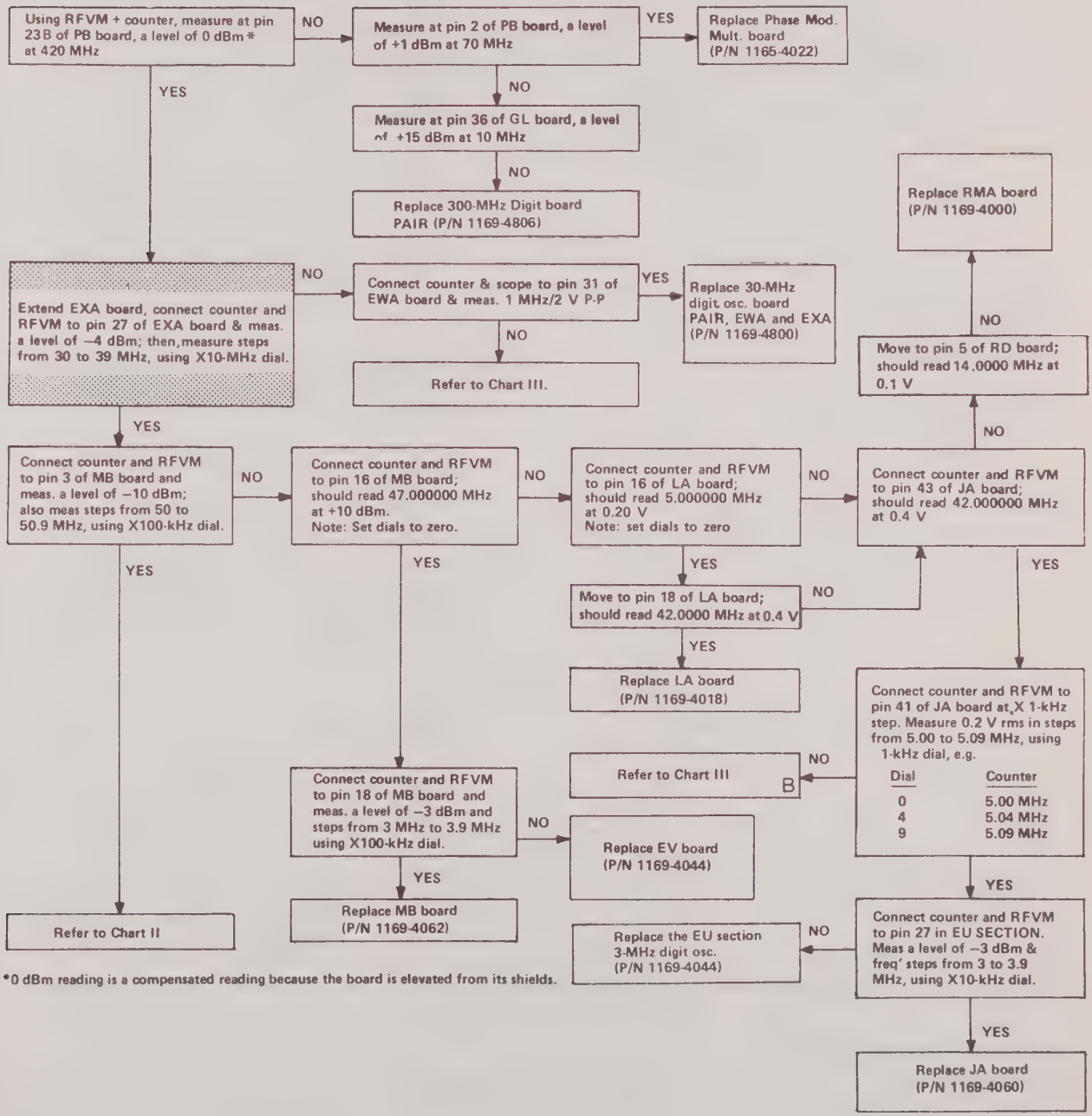
Remove circuit board and replace with extender board, to access test points, except in blocks ▨, which require that circuit board be mounted in extender. Table 5-3 lists appropriate extenders.

CAUTION

See para. 5.11 removal procedures.

TROUBLE ANALYSIS CHART I
COARSE RESOLUTION SECTIONS

continued


Using RFVM + counter, measure at pin 23B of PB board, a level of 0 dBm * at 420 MHz
NO
Measure at pin 2 of PB board, a level of +1 dBm at 70 MHz
YES
Replace Phase Mod. Mult. board (P/N 1165-4022)
YES
NO
Measure at pin 36 of GL board, a level of +15 dBm at 10 MHz
NO
Replace 300-MHz Digit board PAIR (P/N 1169-4806)
Replace RMA board (P/N 1169-4000)
Extend EXA board, connect counter and RFVM to pin 27 of EXA board & meas. a level of −4 dBm; then, measure steps from 30 to 39 MHz, using X10-MHz dial.
NO
Connect counter & scope to pin 31 of EWA board & meas. 1 MHz/2 V P-P
YES
Replace 30-MHz digit osc. board PAIR, EWA and EXA (P/N 1169-4800)
NO
Refer to Chart III.
Move to pin 5 of RD board; should read 14.0000 MHz at 0.1 V
NO
YES
Connect counter and RFVM to pin 3 of MB board and meas. a level of −10 dBm; also meas steps from 50 to 50.9 MHz, using X100-kHz dial.
NO
Connect counter and RFVM to pin 16 of MB board; should read 47.000000 MHz at +10 dBm. Note: Set dials to zero.
NO
Connect counter and RFVM to pin 16 of LA board; should read 5.000000 MHz at 0.20 V Note: set dials to zero
NO
Connect counter and RFVM to pin 43 of JA board; should read 42.000000 MHz at 0.4 V
YES
YES
YES
YES
Move to pin 18 of LA board; should read 42.0000 MHz at 0.4 V
NO
YES
Replace LA board (P/N 1169-4018)
Connect counter and RFVM to pin 41 of JA board at X 1-kHz step. Measure 0.2 V rms in steps from 5.00 to 5.09 MHz, using 1-kHz dial, e.g.
Dial / Counter
0 / 5.00 MHz
4 / 5.04 MHz
9 / 5.09 MHz
Refer to Chart III B
NO
Connect counter and RFVM to pin 18 of MB board and meas. a level of −3 dBm and steps from 3 MHz to 3.9 MHz using X100-kHz dial.
NO
Replace EV board (P/N 1169-4044)
YES
YES
Refer to Chart II
Replace MB board (P/N 1169-4062)
Replace the EU section 3-MHz digit osc. (P/N 1169-4044)
NO
Connect counter and RFVM to pin 27 in EU SECTION. Meas a level of −3 dBm & freq' steps from 3 to 3.9 MHz, using X10-kHz dial.
YES
Replace JA board (P/N 1169-4060)

*0 dBm reading is a compensated reading because the board is elevated from its shields.

TROUBLE ANALYSIS CHART II
UHF ASSEMBLY

Fig. 6-4 for circuits
Fig. 5-12 for locations.

Test Set-up Fig. 5-11

Connect counter and RFVM to J3 on UHF Ass'y; should read 470.444 MHz at +7 dBm.
Note: Set dials to 000444000

NO → Connect RFVM to J2 on UHF Ass'y; a level of −10 dBm should be found.

YES → Replace 470-MHz amplifier P/N 1169-4026 in the UHF ASM.

NO → Connect counter & RFVM to J6. Measure a level of +5 dBm at 420 MHz

YES → Move to pin 1 of MXB mixer (inside) and measure 50/51 MHz at 0 dBm

YES → Replace 470-MHz Output Mixer (P/N 1169-4098). Note: Check 420-MHz inputs at J5.

NO → Repair BF-420 bandpass filter*

NO → Replace 50 MHz amplifier (P/N 1169-4036)

YES → Connect counter & RFVM to J1. Measure a level of +6 dBm at 504.44000 MHz. Note: Set dials to 000444000.

NO → Move RFVM to J7 on UHF Ass'y and measure a level of −13 dBm

YES → Replace 500/510 MHz amplifier board (P/N 1169-4030)

NO → Move RFVM to J4 on UHF Ass'y and measure a level of −12 dBm

YES → Repair 500/510 MHz bandpass filter BP-510*

NO → Connect counter & RFVM to J5 on UHF Ass'y and measure 470/471 MHz at +8 dBm

YES → Move to J8 and measure 30/39 MHz at −4 dBm

YES → Replace 510-MHz mixer (P/N 1169-4095)

NO → Bandpass filter Repair 470-MHz BP-470*

NO → Replace 30-MHz digit oscillator board PAIR (P/N 1169-4800)

YES → Refer to Chart I continued

Note: See para. 5.11 removal procedures to access test points.

*Refer to para 4.3.19.

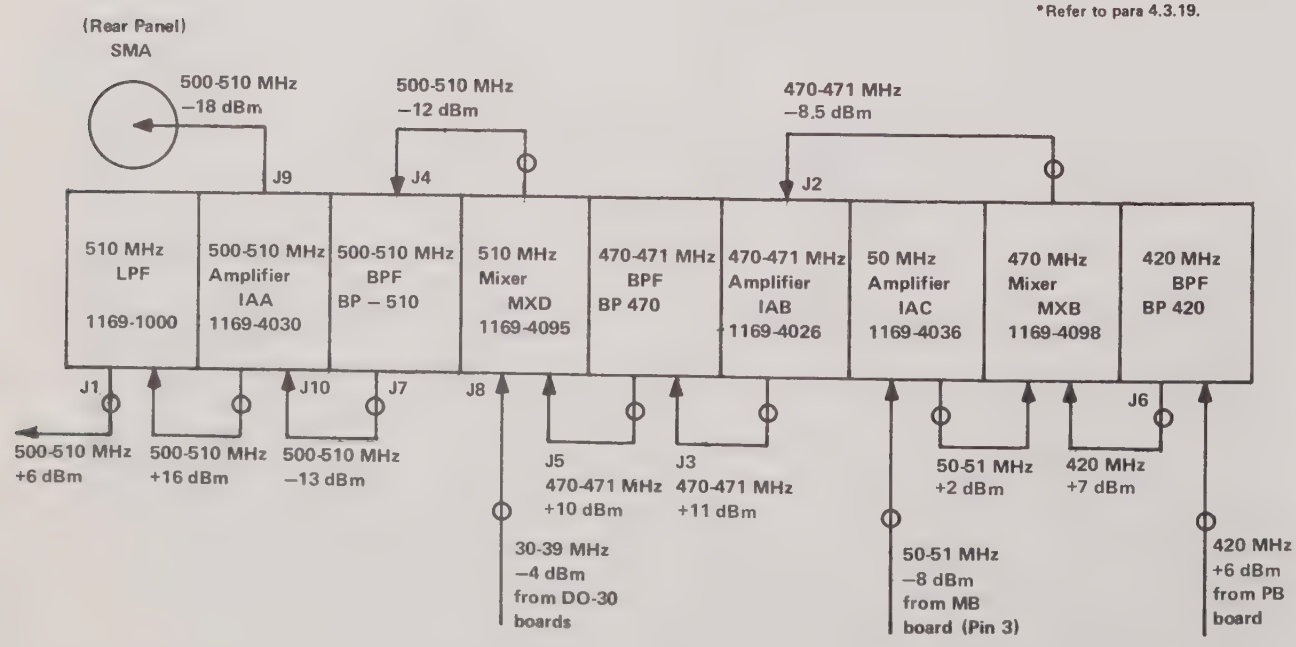
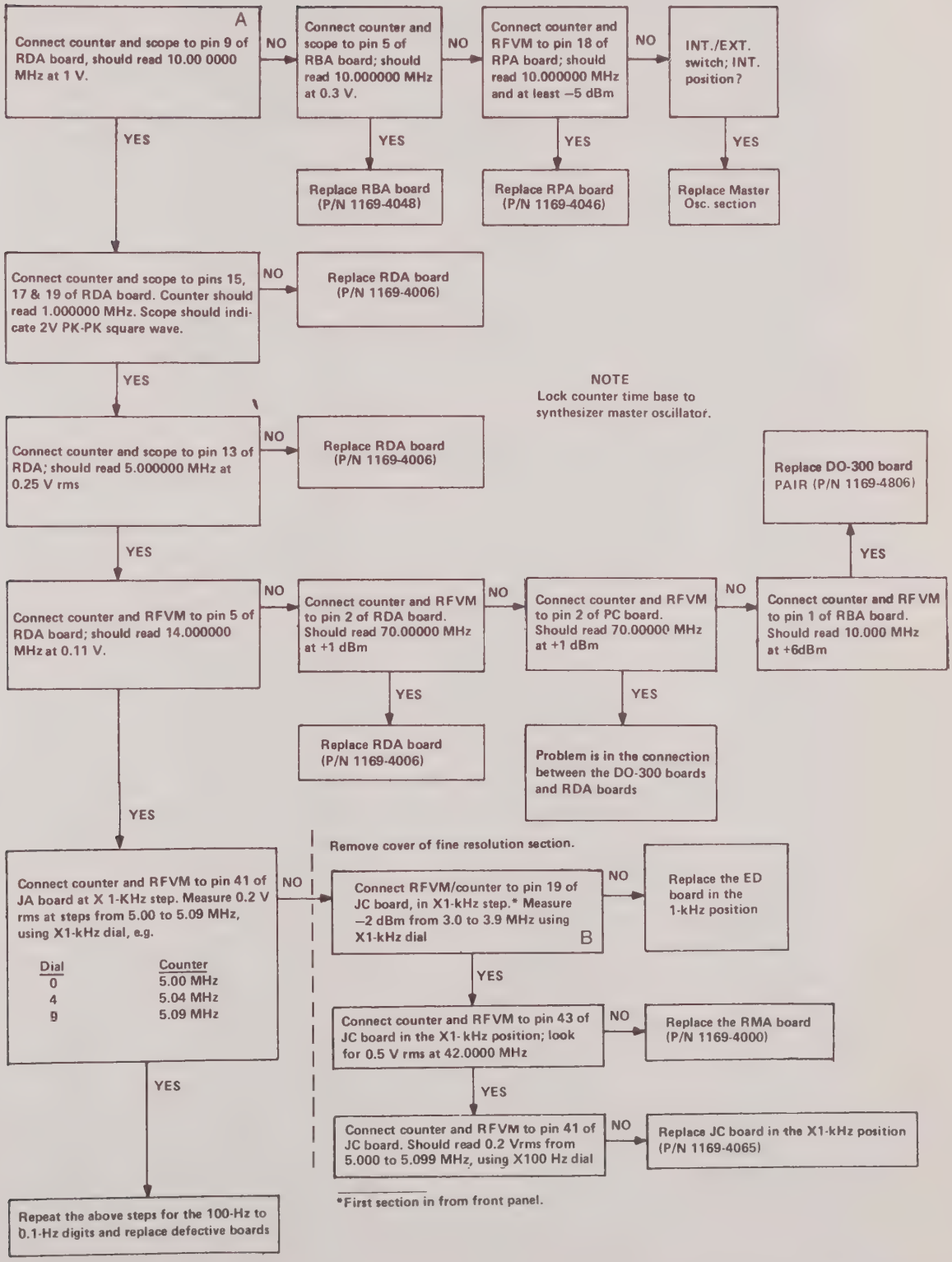


Figure 5-12. UHF Assembly r-f Signal Locator.

TROUBLE ANALYSIS CHART III
FINE RESOLUTION SECTIONS

Test Set-up Fig. 5-11

Fig. 6-5 for circuits
Fig. 5-1 for locations


A
Connect counter and scope to pin 9 of RDA board, should read 10.00 0000 MHz at 1 V.
NO
Connect counter and scope to pin 5 of RBA board; should read 10.000000 MHz at 0.3 V.
NO
Connect counter and RFVM to pin 18 of RPA board; should read 10.000000 MHz and at least −5 dBm
NO
INT./EXT. switch; INT. position?
YES
YES
YES
YES
Replace RBA board (P/N 1169-4048)
Replace RPA board (P/N 1169-4046)
Replace Master Osc. section
Connect counter and scope to pins 15, 17 & 19 of RDA board. Counter should read 1.000000 MHz. Scope should indicate 2V PK-PK square wave.
NO
Replace RDA board (P/N 1169-4006)
YES
NOTE
Lock counter time base to synthesizer master oscillator.
Connect counter and scope to pin 13 of RDA; should read 5.000000 MHz at 0.25 V rms
NO
Replace RDA board (P/N 1169-4006)
Replace DO-300 board PAIR (P/N 1169-4806)
YES
YES
Connect counter and RFVM to pin 5 of RDA board; should read 14.000000 MHz at 0.11 V.
NO
Connect counter and RFVM to pin 2 of RDA board. Should read 70.00000 MHz at +1 dBm
NO
Connect counter and RFVM to pin 2 of PC board. Should read 70.00000 MHz at +1 dBm
NO
Connect counter and RFVM to pin 1 of RBA board. Should read 10.000 MHz at +6dBm
YES
YES
Replace RDA board (P/N 1169-4006)
Problem is in the connection between the DO-300 boards and RDA boards
YES
Remove cover of fine resolution section.
Connect counter and RFVM to pin 41 of JA board at X 1-KHz step. Measure 0.2 V rms at steps from 5.00 to 5.09 MHz, using X1-kHz dial, e.g.
Dial 0 — Counter 5.00 MHz
Dial 4 — Counter 5.04 MHz
Dial 9 — Counter 5.09 MHz
NO
Connect RFVM/counter to pin 19 of JC board, in X1-kHz step.* Measure −2 dBm from 3.0 to 3.9 MHz using X1-kHz dial
B
NO
Replace the ED board in the 1-kHz position
YES
YES
Connect counter and RFVM to pin 43 of JC board in the X1- kHz position; look for 0.5 V rms at 42.0000 MHz
NO
Replace the RMA board (P/N 1169-4000)
YES
Connect counter and RFVM to pin 41 of JC board. Should read 0.2 Vrms from 5.000 to 5.099 MHz, using X100 Hz dial
NO
Replace JC board in the X1-kHz position (P/N 1169-4065)
Repeat the above steps for the 100-Hz to 0.1-Hz digits and replace defective boards
*First section in from front panel.

TROUBLE ANALYSIS CHART IV

POWER SUPPLY SECTION

Fig. 6-31 for circuits
Fig. 5-1 for locations

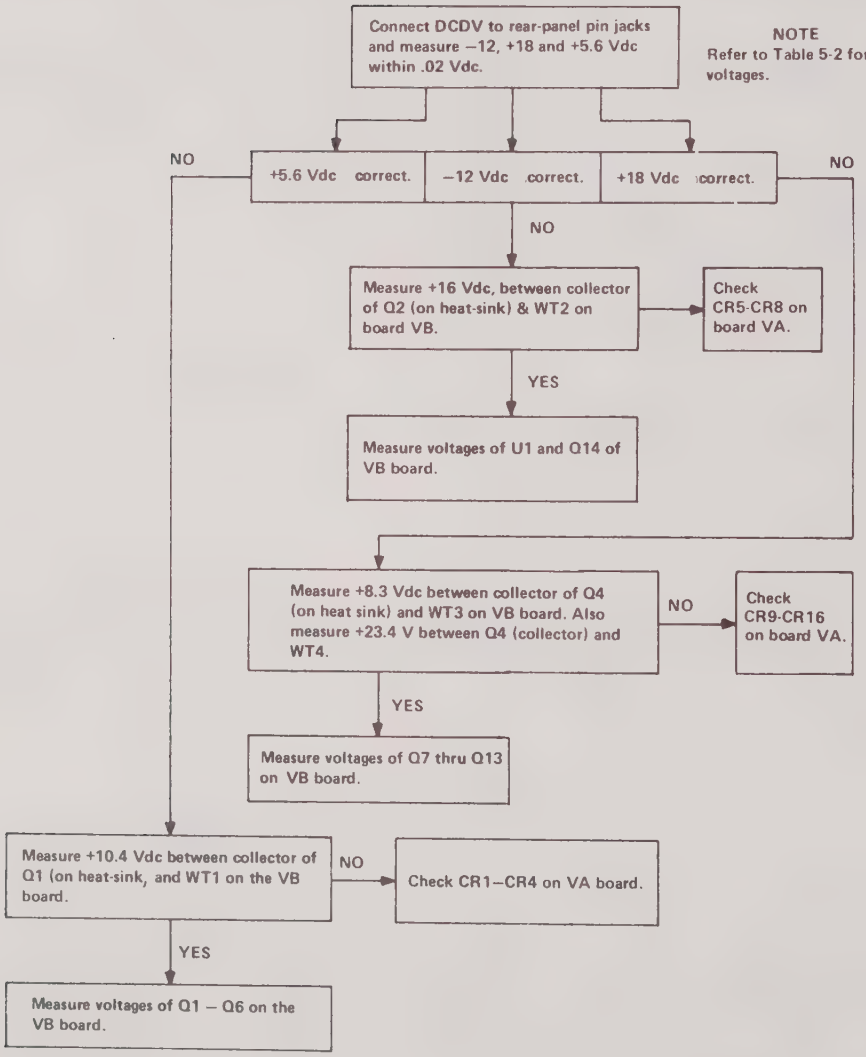

Connect DCDV to rear-panel pin jacks and measure −12, +18 and +5.6 Vdc within .02 Vdc.
NOTE
Refer to Table 5-2 for device voltages.
NO
+5.6 Vdc correct.
−12 Vdc correct.
+18 Vdc correct.
NO
NO
Measure +16 Vdc, between collector of Q2 (on heat-sink) & WT2 on board VB.
Check CR5-CR8 on board VA.
YES
Measure voltages of U1 and Q14 of VB board.
Measure +8.3 Vdc between collector of Q4 (on heat sink) and WT3 on VB board. Also measure +23.4 V between Q4 (collector) and WT4.
NO
Check CR9-CR16 on board VA.
YES
Measure voltages of Q7 thru Q13 on VB board.
Measure +10.4 Vdc between collector of Q1 (on heat-sink, and WT1 on the VB board.
NO
Check CR1−CR4 on VA board.
YES
Measure voltages of Q1 − Q6 on the VB board.

Table 5-4

TYPICAL SIGNAL LEVELS AT TEST POINTS

Circuit Section (Figs. 6-4/6-5)	Signal	Board Pin No.	Nominal Impedance (Ohms)	System Level Window
MO	5/10 MHz, OUT	4	50	–5 to +21 dBm
RP	5/10 MHz, IN	18	50	–5 to +21 dBm
RP	10 MHz, OUT	2	130	0.28 V Set
RB	10 MHz, IN	5	130	0.28 V Set
RB	10 MHz, OUT	18	50	+6 to +8 dBm
RB	10 MHz, OUT	1	50	+14 to +16 dBm
RB	10 MHz, OUT	15	330	1.0 to 1.4 V
RD	10 MHz, IN	9	330	1.0 to 1.4 V
RD	5 MHz, OUT	13	500	0.23 to 0.28 V
RD	1 MHz, OUT	17	200/1k	2 Vpp, Min
RD	1 MHz, OUT	15	500	2 Vpp, Min
RD	1 MHz, OUT	19	1k	2 Vpp, Min
RD	70 MHz, IN	2	75	.036 to .044 V
RD	14 MHz, OUT	5	1k	0.11 to 0.13 V
H	42 MHz, IN	J3	100	0.4 to 0.6 V
H	1 MHz, IN	J5	200/1k	2 Vpp, Min
H	5 MHz, IN	J4	500	0.23 to 0.28 V
H	5.0 to 5.1 MHz, OUT	J2	500	0.16 to 0.24 V
RM	14 MHz, IN	5	1k	0.11 to 0.13 V
RM	42 MHz, OUT	15	100	0.4 to 0.6 V
RM	42 MHz, OUT	18	500	0.4 to 0.6 V
RM	42 MHz, OUT	1	500	0.4 to 0.6 V
J	42 MHz, IN	43	500	0.4 to 0.6 V
J	5.0 to 5.1 MHz, IN	41	500	0.16 to 0.24 V
J	3.0 to 3.9 MHz, IN	19	50	–3 to –1 dBm
J	5.0 to 5.1 MHz, OUT	3	500	0.16 to 0.24 V
L	5.0 to 5.1 MHz, IN	16	500	0.16 to 0.24 V
L	47 to 47.1 MHz, OUT	3	50	+10 dBm Set
L	42 MHz, IN	18	500	0.4 to 0.6 V
MT	47 to 47.1 MHz, IN	16	50	+10 dBm Set
MT	3.0 to 3.9 MHz, IN	18	50	–3 to –1 dBm
MT	50 to 51 MHz, OUT	3	50	–10 to –6 dBm
UHF	50 to 51 MHz, IN	P6	50	–10 to –6 dBm
UHF	420 MHz, IN	P7	50	+6 to +10 dBm
UHF	500 to 510 MHz, OUT	J1	50	+6 to +8 dBm
UHF	500 to 510 MHz, IN	J9	50	–18 to –15 dBm
UHF	30 to 39 MHz, IN	J8	50	–4 to –2 dBm
OA	0 to 500 MHz, IN	43	50	–29 to –24 dBm
OA	0 to 500 MHz, OUT	J2	50	–7 to +13 dBm
P	70 MHz, IN	2A	75	0.34 V Set
P	70 MHz, OUT	6A	150	0.34 V Set
P	420 MHz, OUT	23B	50	+6 to +10 dBm
GX	70 MHz, OUT	42	50	+3.5 dBm, Set
GX	10 MHz, IN	36	50	+14 to +16 dBm
GY	300 to 210 MHz, OUT	44	50	–8.5 to –5.5 dBm
EW	1 MHz, IN	31	1k	2 Vpp, Min
EX	30 to 39 MHz, OUT	27	50	–4 to –2 dBm
EV	3 to 3.9 MHz, OUT	27	50	–3 to –1 dBm
EV	1 MHz, IN	3	1k	2 Vpp, Min
EU	1 MHz, OUT	5	1k	2 Vpp, Min
EU	1 MHz, IN	3	500	2 Vpp, Min
EU	3 to 3.9 MHz, OUT	27	50	–3 to –1 dBm

NOTE: "NOM IMP.": Input Impedance or Nominal Load Impedance (for Output).

Table 5-5

TYPICAL SPURIOUS FREQUENCY AND NOISE RELATED SIGNAL LEVELS

Circuit Section (Figs. 6-4/6-5)	Signal	Board Pin No.	Nominal Impedance (Ohms)	Remarks
MO	5/10 MHz, OUT	4	50	HARMONICS <–30 dB
RP	10 MHz, OUT	2	130	HARMONICS <–55 dB
RB	10 MHz, OUT	18	50	HARMONICS <–35 dB
RB	10 MHz, OUT	1	50	HARMONICS <–30 dB
RB	10 MHz, OUT	15		HARMONICS <–35 dB
RD	14 MHz, OUT	5		HARMONICS <–30 dB
H	5.0 to 5.1 MHz, OUT	J2		All <–66 dB
RM	42 MHz, OUT	15		±5 MHz, –40 dB; ±14 MHz, –50 dB
RM	42 MHz, OUT	18		±5 MHz, –40 dB; ±14 MHz, –50 dB
RM	42 MHz, OUT	1		±2 MHz, –80 dB; ±5 MHz, <–60 dB
J	5.0 to 5.1 MHz, OUT	3		All <–86 dB
L	47 to 47.1 MHz, OUT	3		42 MHz, –70 dB; 52 MHz, –80 dB
MT	50 to 51 MHz, OUT	3		44 MHz, –50 dB; 47 MHz, –47 dB; 53 MHz, –55 dB
UHF	420 MHz, IN	P7		+10 MHz, –86 dB/±210 MHz, –28 dB
UHF	500 to 510 MHz, OUT	J1		All <–86 dB
OA	0 to 500 MHz, OUT	J2		All <–83 dB
P	420 MHz, OUT	23B		±10 MHz, –86 dB/±210 MHz, –28 dB
GX	70 MHz, OUT	42		±10 MHz, <–28 dB
GY	300 to 210 MHz, OUT	44		±10 MHz, <–86 dB
EX	30 to 39 MHz, OUT	27		±N x 1 MHz <–86 dB
EV	3 to 3.9 MHz, OUT	27		±N x 1 MHz <–86 dB
EU	3 to 3.9 MHz, OUT	27		±N x 1 MHz, <–80 dB
K	100 MHz, IN	J48	50	–15.5 dBm
K	500 to 510 MHz, IN	J40	50	–6 to –48 dBm
K	300 to 210 MHz, IN	J47	50	–8.5 to –5.5 dBm
K	0 to 500 MHz, OUT	J42	50	–29 to –24 dBm
K	2.27 to 2.18 GHz, OUT	J41	50	–1.6 to +3.2 dBm
K	1.77 to 2.17 GHz, OUT	J45	50	–.5 to +4 dBm
K	2.27 to 2.18 GHz, OUT	J41		All <–84 dB
K	100/200 MHz, IN	J43	50	+1 dBm SET
PM	500 to 510 MHz, IN	J2	50	+6 to +8 dBm
PM	500 to 510 MHz, OUT	J1	50	–6 to –48 dBm

NOTE: All = All frequencies.

Parts Lists and Diagrams – Section 6

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Level Detector	6-35
Pin Modulator	6-35
Phase modulator	6-37
Phase modulator multiplier	6-39
Reference buffer	6-41
Reference divider	6-43
Reference multiplier	6-45
Reference processor	6-47
Search/Sweep driver	6-49
UHF Section	6-50
UHF Section Amplifiers and Mixers	6-51
UHF Section 510-MHz Amplifier	6-53
Power Supply	6-55
Microwave Assembly	6-56

CROSS-INDEX BY BOARD PART NO.

Part No.	Pages	Part No.	Pages
1165-4022	6-38/-39	1169-4055	6-54/-55
1169-4000	6-44/-45	1169-4057	6-34/-35
1169-4006	6-42/-43	1169-4060	6-24/-25
1169-4008	6-36/-37	1169-4062	6-28/-29
1169-4010	6-20/-21	1169-4065	6-24/-25
1169-4018	6-26/-27	1169-4068	6-56/-57
1169-4020	6-50/-51	1169-4074	6-56/-57
1169-4022	6-48/-49	1169-4076	6-34/-35
1169-4024	6-12/-13	1169-4082	6-58/-59
1169-4026	6-50/-51	1169-4084	6-58/-59
1169-4030	6-52/-53	1169-4088	6-58/-59
1169-4032	6-30/-31	1169-4090	6-22/-23
1169-4033	6-30/-31	1169-4094	6-14/-15
1169-4036	6-50/-51	1169-4095	6-50/-51
1169-4044	6-10/-11	1169-4096	6-16/-17
1169-4046	6-46/-47	1169-4098	6-50/-51
1169-4048	6-40/-41	1169-4110	6-54/-55
1169-4050	6-54/-55	1169-4131	6-30/-31
1169-4052	6-32/-33	1169-4140	6-50/-51
1169-4053	6-18/-19	1169-4180	6-56/-57

NOTE

Electrical parts information in this section is presented such that all information for a part-numbered subassembly is visible in a single opening of the manual. Thus, the parts list appears on left-hand pages, while the part-location diagram (on the apron) and the schematic diagram (tip out) are on right-hand pages. Most of the subassemblies are plug-in boards, to permit rapid replacement should failure occur.

NOTE: In the enclosure base assembly, the multipin connectors that mate with the etched-circuit connectors take corresponding pin numbers (shown along the top outline of the assembly on the schematic) and bear the reference-designator prefix "S0" in the parts list and on the layout drawing, shown adjacent to the etched-circuit diagram.

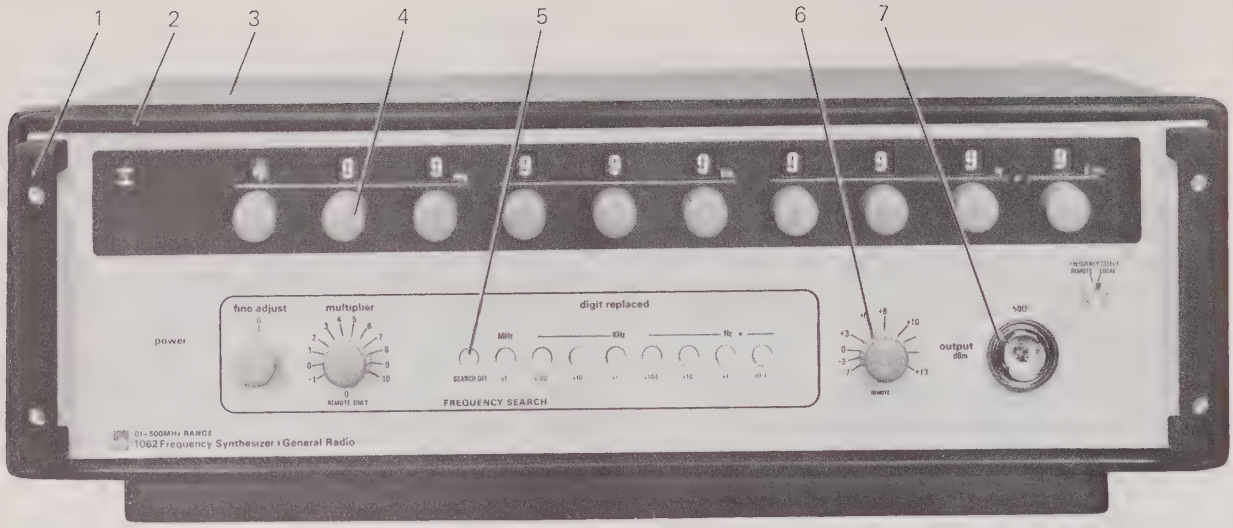


Figure 6-1. Mechanical parts, front panel, Option 1 versions only.

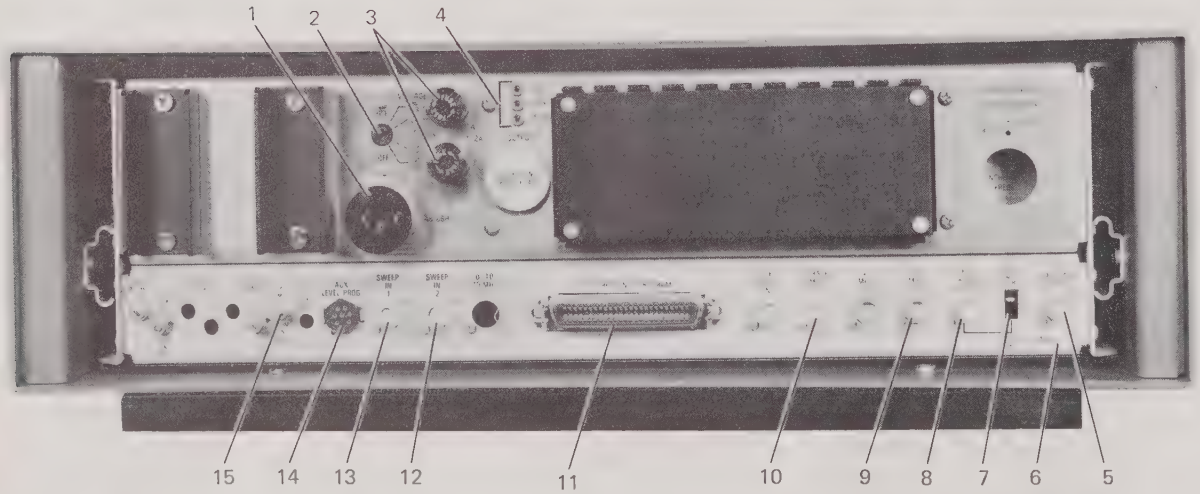


Figure 6-2. Mechanical parts, rear panel.

MECHANICAL PARTS LIST

Fig Ref	Qnt	Description	GR Part No.	Fed Mfg Code	Mfg Part No.
FRONT PANEL					
1	2	Handle	5360-2012	24655	5360-2012
2	1	Cabinet gasket	5331-2168	24655	5331-2168
3	1	Bench cabinet asm. includes:			
	1	bench cabinet	4173-3843	24655	4173-3843
	1	base	4171-1077	24655	4171-1077
	2	foot	4171-7022	24655	4171-7022
4	10	Knob asm., grey includes: retainer	5220-5402	24655	5220-5402
5	1	Knob, pushbutton, multiple 9, A-S14 DIGIT REPLACED	5511-0402	24655	5511-0402
6	3	Knob asm. grey	5520-5221	24655	5520-5221
7	1	Connector, bulkhead,	4260-1190	08168	2004-7985

MECHANICAL PARTS LIST

Fig Ref	Qnt	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
REAR PANEL						
1	1	Receptacle, Power, C.E.E., Std., J-1	4240-0210	24655	4240-0210	
2	1	Switch, Line Voltage, S-1 LINE VOLTAGE/OFF 90/110, 104/127, 180/220, 194/236, 207/253	7890-1382	24655	7890-1382	
3	2	Fuse Extractor Post XF-1,2 1A/1/2 A	5650-0100	71400	HKP-H	5920-284-7144
4	3	Connector, Jack J-3,4,5 +18 V, -12 V, +5.6 V	4260-1010	91916	SKT-8	
5	1	Cable Asm., BNC A-J33 DC FREQUENCY CONTROL	1169-2200	24655	1169-2200	
6	1	Connector, jack A-J34 BAT	4270-0975	07264	#FT-M-8	
7	1	Switch, Slide, DPDT A-S20 INT OFF	7910-0832	82389	11A-1118	
8	1	Cable Asm., BNC A-J32 EXT REF INPUT	1169-2204	24655	1169-2204	
9	1	Cable Asm. A-J31	1169-2850	24655	1169-2850	
10	1	Connector, BNC A-J29 PHASE MOD IN	1169-2854	24655	1169-2854	
11	1	Connector A-J8 BCD FREQUENCY PROGRAM	4230-4049	93916	57-40500	5935-062-1776
12	1	Cable Asm. A-J26 SWEEP IN 2	1169-2858	24655	1169-2858	
13	1	Cable Asm. A-J25 SWEEP IN 1	1169-2852	24655	1169-2852	
14	1	Connector, Mult., Socket, 7 cont. A-J43 AUX LEVEL PROG	4230-5406	02660	126-198	
15	1	Cable Asm. A-J41 42 MHZ/TERM IN 50 Ω	1169-2550	24655	1169-2550	

Table 6-1
TYPE 1062 PLUG-IN CIRCUIT ASSEMBLIES

Function	Section	Plug-In Board	Board Part Number	Enclosure Base Part Number	Descriptive Name	Abbreviated Name
Fixed Freq Ref Chain	RP	RPA	1169-4046	1169-2052	Reference Processor	RP-10
	RB	RBA	1169-4048	1169-2047	Reference Buffer	RB-10
	RD	RDA	1169-4006	1169-2007	Reference Divider	RD-10
	RM	RMA	1169-4000	1169-2047	Reference Multiplier	RM-42
	P	PC PB	1169-4008 1165-4022	1169-2078	Phase Modulator Phase Modulator Multiplier	PM-420
Digit Oscillator	GX	GL	1169-4053*	1169-2012	300-MHz Digit Osc. Sampler	DO-300
	GY	GK	1169-4010*	1169-2042	300-MHz Digit Oscillator	
	EW	EWA	1169-4094†	1169-2650	30-MHz Digit Osc. Sampler	DO-30
	EX	EXA	1169-4096†	1169-2023	30-MHz Digit Oscillator	
	EU	ED	1169-4044	1169-2023	3-MHz Digit Oscillator	DO-3
	EV	ED	1169-4044	1169-2023	3-MHz Digit Oscillator	DO-3
	H°	ED	1169-4044	Mother Board	3-MHz Digit Oscillator	DO-3
Intermediate Mixers	MT	MB	1169-4062	1165-2031	Intermediate Mixer (51 MHz)	IM-51
	L	LA	1165-4018	1165-2031	Intermediate Mixer (47 MHz)	IM-47
Intermediate Mixer/Divider	J	JA	1169-4060	1165-2026	5.1-MHz Mixer Divider	IMD-5.1
	H°	JC	1169-4065	Mother Board	5.1-MHz Mixer Divider	IMD-5.1
Bridging Unit Board	H°	BUB	1169-4080	Mother Board	Bridging Unit Board	BUB
Output Amplifier	OA	OAC	1169-4052	1169-2082	Output Amplifier	OA-500

NOTES: * Adjusted board pair
† Adjusted board pair

° Up to five pairs of ED and JC boards used in Section H with BUB in all unoccupied JC stations on Mother Board.

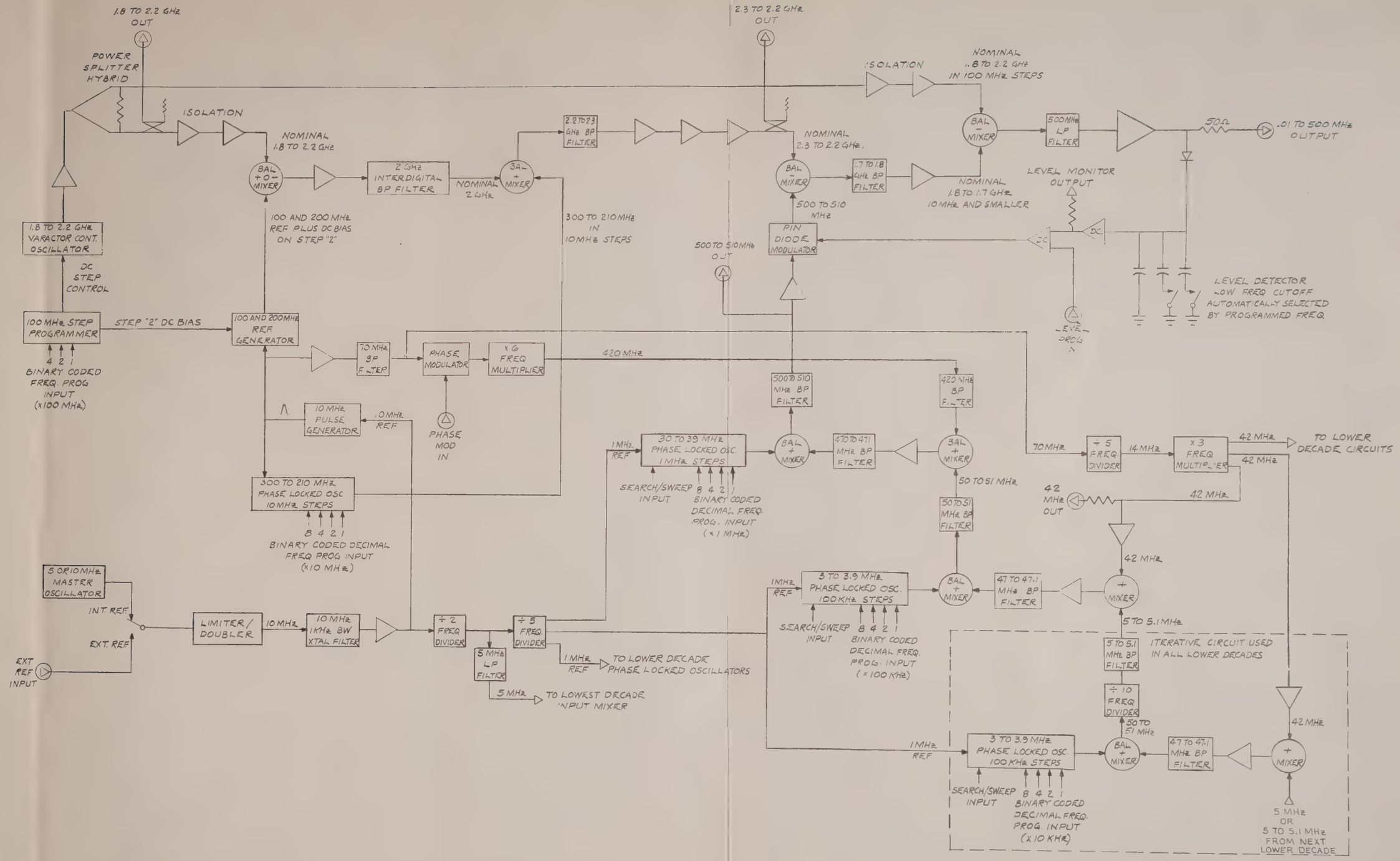
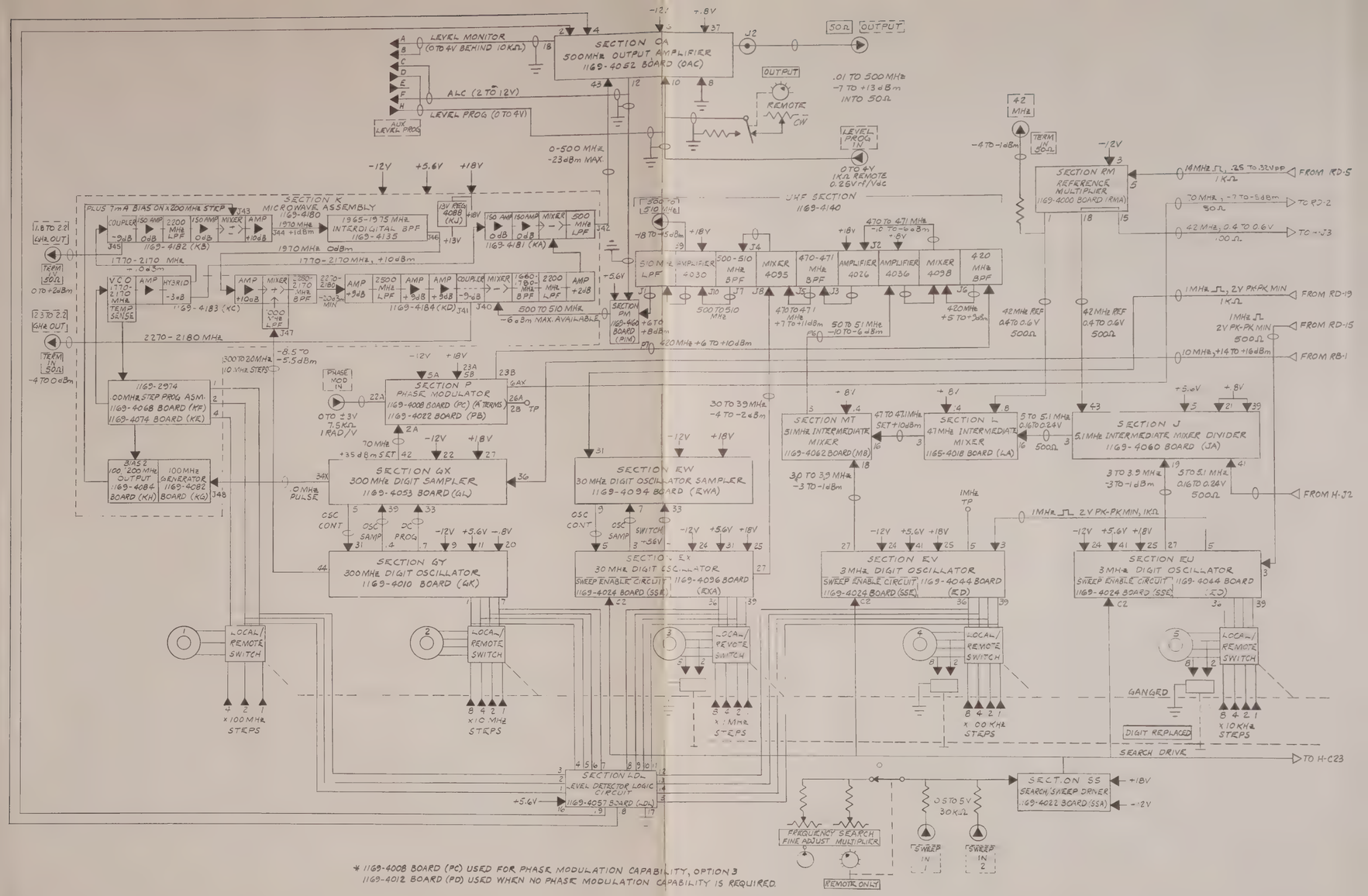

1.8 TO 2.2 GHz OUT
2.3 TO 2.2 GHz OUT
POWER SPLITTER HYBRID
ISOLATION
NOMINAL 1.8 TO 2.2 GHz
BAL + O - MIXER
2 GHz INTERDIGITAL BP FILTER
NOMINAL 2 GHz
3A- + MIXER
2.2 TO 2.3 GHz BP FILTER
NOMINAL 2.3 TO 2.2 GHz.
BAL - MIXER
1.7 TO 1.8 GHz BP FILTER
NOMINAL 1.8 TO 1.7 GHz 10 MHz AND SMALLER
ISOLATION
NOMINAL 1.8 TO 2.2 GHz IN 100 MHz STEPS
BAL - MIXER
500 MHz LP FILTER
50Ω
.01 TO 500 MHz OUTPUT
LEVEL MONITOR OUTPUT
1.8 TO 2.2 GHz VARACTOR CONT. OSCILLATOR
DC STEP CONTROL
100 AND 200 MHz REF PLUS DC BIAS ON STEP "2"
300 TO 210 MHz IN 10 MHz STEPS
500 TO 510 MHz
PIN DIODE MODULATOR
500 TO 510 MHz OUT
DC
DC
LEVEL DETECTOR LOW FREQ CUTOFF AUTOMATICALLY SELECTED BY PROGRAMMED FREQ.
LEVEL PROG X
100 MHz STEP PROGRAMMER
STEP "2" DC BIAS
100 AND 200 MHz REF GENERATOR
4 2 1 BINARY CODED FREQ. PROG INPUT (x100 MHz)
70 MHz BP FILTER
PHASE MODULATOR
x 6 FREQ MULTIPLIER
420 MHz
500 TO 510 MHz BP FILTER
420 MHz BP FILTER
10 MHz PULSE GENERATOR
.0 MHz REF
PHASE MOD IN
1 MHz REF
30 TO 39 MHz PHASE LOCKED OSC. 1 MHz STEPS
BAL + MIXER
470 TO 471 MHz BP FILTER
BAL + MIXER
70 MHz
÷ 5 FREQ. DIVIDER
14 MHz
x 3 FREQ MULTIPLIER
42 MHz
TO LOWER DECADE CIRCUITS
42 MHz
SEARCH/SWEEP INPUT
8 4 2 1 BINARY CODED DECIMAL FREQ. PROG. INPUT (x 1 MHz)
50 TO 51 MHz
300 TO 210 MHz PHASE LOCKED OSC 10 MHz STEPS
8 4 2 1 BINARY CODED DECIMAL FREQ PROG INPUT (x 10 MHz)
50 TO 51 MHz BP FILTER
42 MHz OUT
42 MHz
5 OR 10 MHz MASTER OSCILLATOR
INT REF.
EXT. REF
EXT REF INPUT
LIMITER / DOUBLER
10 MHz
10 MHz 1 KHz BW XTAL FILTER
÷ 2 FREQ DIVIDER
÷ 5 FREQ. DIVIDER
5 MHz LP FILTER
5 MHz
TO LOWEST DECADE INPUT MIXER
1 MHz REF
TO LOWER DECADE PHASE LOCKED OSCILLATORS
1 MHz REF
3 TO 3.9 MHz PHASE LOCKED OSC. 100 KHz STEPS
BAL + MIXER
47 TO 47.1 MHz BP FILTER
+ MIXER
5 TO 5.1 MHz
SEARCH/SWEEP INPUT
8 4 2 1 BINARY CODED DECIMAL FREQ. PROG. INPUT (x 100 KHz)
5 TO 5.1 MHz BP FILTER
ITERATIVE CIRCUIT USED IN ALL LOWER DECADES
÷ 10 FREQ DIVIDER
50 TO 51 MHz
1 MHz REF
3 TO 3.9 MHz PHASE LOCKED OSC. 100 KHz STEPS
BAL + MIXER
47 TO 47.1 MHz BP FILTER
+ MIXER
42 MHz
SEARCH/SWEEP INPUT
8 4 2 1 BINARY CODED DECIMAL FREQ. PROG. INPUT (x 10 KHz)
5 MHz OR 5 TO 5.1 MHz FROM NEXT LOWER DECADE

Figure 6-3. Functional diagram — over-all synthesizer.



* 1169-4008 BOARD (PC) USED FOR PHASE MODULATION CAPABILITY, OPTION 3
1169-4012 BOARD (PD) USED WHEN NO PHASE MODULATION CAPABILITY IS REQUIRED.

Figure 6-4. Block diagram — Part 1 — coarse resolution and output sections (1 of 2).

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.
1169-4500	10 MHz FINE STRUCTURE PACKAGE			
CAPACITORS				
A-C1 and A-C2	Cer., Feed-Thru, 1000 pF +100-0%	4400-2200	01121	FA5C, 1000 pF
A-P2 C21 thru	Cer., Feed-Thru, 1000 pF +100-0%	4400-2200	01121	FA5C, 1000 pF
C24	Cer., Feed-Thru, 1000 pF +100-0%	4400-2200	01121	FA5C, 1000 pF
CHOKES				
A-L3	Mult. Socket, 7 Cont.	4300-6500	99800	2150, 10 µH ±10%
CONNECTORS				
J3 thru J6	RF Insert	1165-6020	24655	1165-6020
A-J10	EC, 15 Pos SR	4230-2710	95354	91-6010-1201-00
A-J43	Mult. Socket, 7 Cont.	4230-5406	02660	126-198
A-J34	Plug	4260-1010	07264	FT-M-8
RESISTORS				
A-R30	Comp., 2 k Ω ±5% 1/4 W	6099-2205		
A-R50	Comp., 10 Ω ±5% 1/4 W	6099-0105	75042	BTS, 10 Ω ±5%
SWITCHES				
A-S20	Slide, DPDT	7910-0832	82389	11A-1118
1169-4502				
CAPACITOR				
C3	Ceramic Trimmer 2-8 pF Npo	4910-2042	72982	538-000
INDUCTOR				
L1	Choke Molded 1.0 µH ±10%	4300-0700	99800	1537 1.0 µH ±10%

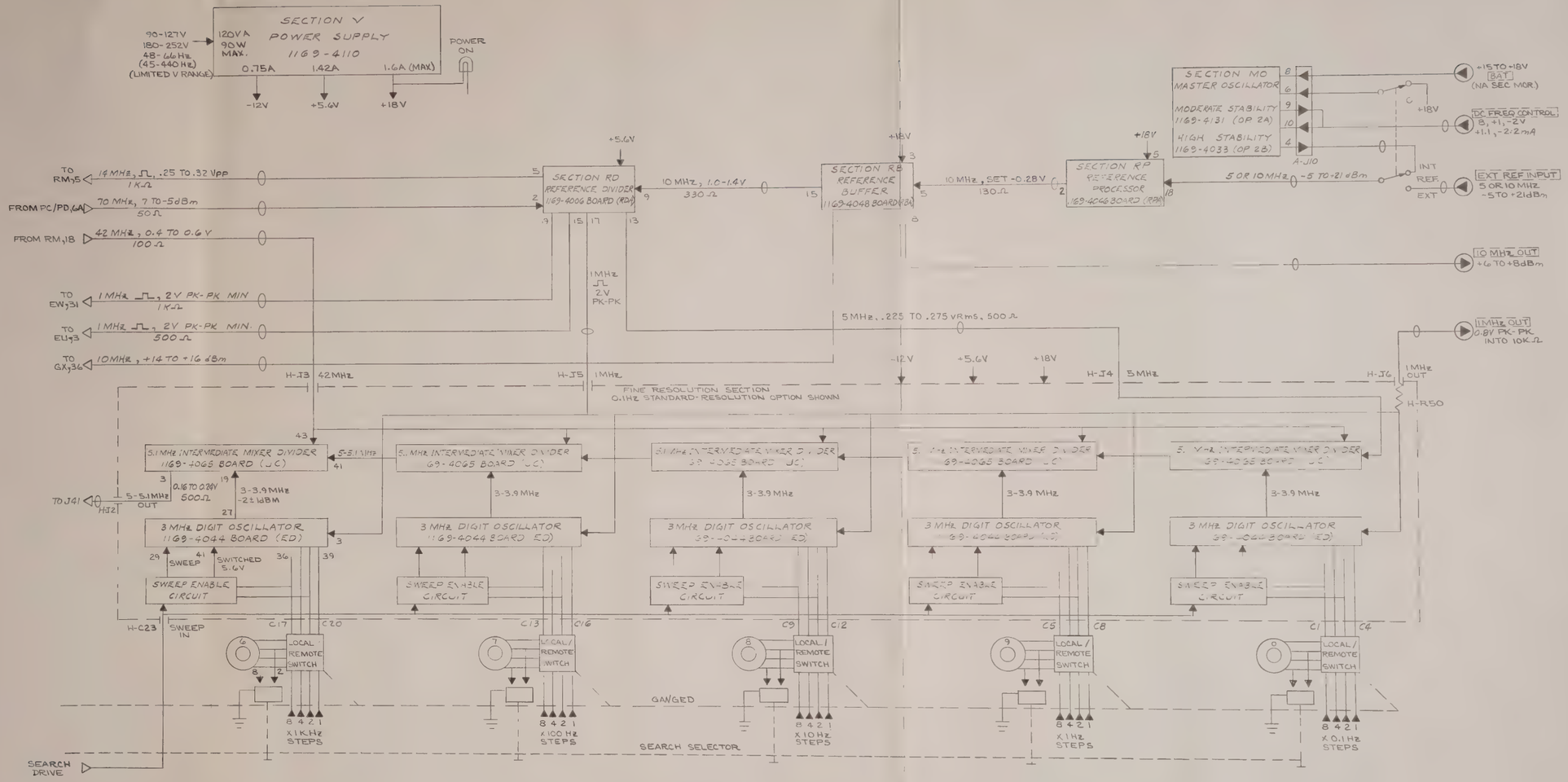


Figure 6-5. Block diagram — Part 2 — fine-resolution, frequency-reference and power-supply sections (2 of 2).

FEDERAL MANUFACTURER'S CODE

From Federal Supply Code for Manufacturers Cataloging Handbooks H4-1
(Name to Code) and H4-2 (Code to Name) as supplemented through August, 1968.

Code	Manufacturer
00136	McCoy Electronics Co., Mt. Holly Springs, PA 17065
00192	Jones Mfg. Co., Chicago, IL 60607
00194	Walsco Electronics Corp., Los Angeles, CA 90053
00327	Welwyn International, Westlake, OH 44145
00434	Schweber Electronics, Westburg, NY 11590
00656	Aerovox Corp., New Bedford, MA 02745
00779	Amp, Inc., Harrisburg, PA 17105
01009	Alden Products Co., Brockton, MA 02413
01121	Allen-Bradley Co./Electronics Div., Milwaukee, WI 53204
01255	Litton Industries Inc., Beverly Hills, CA 90213
01295	Texas Instruments, Inc., Dallas, TX 75222
01930	Amerock, Corp., Rockford, IL 61101
02111	Spectrol Electronics Corp., City of Industry, CA 91745
02114	Ferroxcube Corp., Saugerties, NY 12477
02606	Fenwal Lab Inc., Morton Grove, IL 60053
02660	Amphenol Electron Corp., Broadview, IL 60153
02768	Fastex, Des Plains, IL 60016
03042	Carter Ink Co., Cambridge, MA 02142
03508	G. E. Semicon Prod., Syracuse, NY 13201
03636	Grayburne, Yonkers, NY 10701
03877	Transitron Electronics, Wakefield, MA 01880
03911	Clairex Corp., New York, NY 10001
04009	Arrow Hart, Hartford, CT 06106
04643	Digitronics Corp., Albertson, NY 11507
04713	Motorola, Phoenix, AZ 85008
04919	Component Mfg. Service, Inc., West Bridgewater, MA 02379
05079	Tansitor Electronics, Bennington, VT 05201
05402	Controls Co. of America, Melrose Park, IL 60160
05574	Viking Industries, Inc., Chatsworth, CA 91311
05624	Barber-Colman Co., Rockford, IL 61101
05748	Barnes Mfg. Co., Mansfield, OH 44901
05820	Wakefield Engineering Inc., Wakefield, MA 01880
06743	Clevite Corp., Cleveland, OH 44110
07126	Digitran Co., Pasadena, CA 91105
07127	Eagle Signal (E.W. Bliss Co.), Baraboo, WI 53913
07233	Cinch Graphik, City of Industry, CA 91744
07261	Avnet Corp., Culver City, CA 90230
07263	Fairchild Semiconductor, Mountain View, CA 94040
07387	Birtcher Corp., No. Los Angeles, CA 90032
07595	Amer. Semiconductor, Arlington Hts, IL 60004
07828	Bodine Corp., Bridgeport, CT 06605
07829	Bodine Electric Co., Chicago, IL 60618
07910	Cont. Device Corp., Hawthorne, CA 90250
07983	State Labs, Inc., New York, NY 10003
07999	Borg Instruments, Delavan, WI 53115
08730	Vemaline Products Co., Franklin Lakes, NJ 07417
09213	G. E. Semiconductor, Buffalo, NY 14207
09353	C & K Components Inc., Watertown, MA 02172
09408	Star-Tronics Inc., Georgetown, MA 01830
09823	Burgess Battery Co., Freeport, IL 61032
09856	Fenwal Electronics, Inc., Framingham, MA 01701
09922	Burndy Corp., Norwalk, CT 06852
11236	CTS of Berne, Inc., Berne, IN 46711
11599	Chandler Evans Corp., W. Hartford, CT 06101
11983	Nortronics Co., Inc., Minneapolis, MN 55427
12040	National Semiconductor, Santa Clara, CA 95051
12045	Electronic Transistors Corp., Flushing, NY 11354
12498	Teledyne Semiconductor, Mountain View, CA 94043
12617	Hamlin, Inc., Lake Millis, WI 53551
12672	R. C. A., Woodbridge, NJ 07095
12697	Clarostat Mfg. Co., Inc., Dover, NH 03820
12954	Dickson Electronics Corp., Scottsdale, AZ 85252
12969	Unitrode Corp., Watertown, MA 02172
13094	Electrocraft Corp., Hopkins, MN 55343
13103	Thermalloy, Inc., Dallas, TX 75234
13327	Solitron Devices, Tappan, NY 10983
13919	Burr Brown Research Corp., Tucson, AZ 85706
14195	Electronic Controls, Inc., Wilton, CT 06897
14433	I.T.T. Semiconductors, W. Palm Beach, FL 33402
14482	Watkins & Johnson Co., Palo Alto, CA 94304
14655	Cornell Dubilier Electronics, Newark, NJ 07101
14674	Corning Glass Works, Corning, NY 14830
14749	Acopian, Easton, PA 18042
14752	Electro Cube, Inc., San Gabriel, CA 91776
14936	General Instrument Corp., Hicksville, NY 11802
15116	Microdot Magnetics, Inc., Los Angeles, CA 90053
15238	I.T.T. Semiconductors, Lawrence, MA 08142
15476	Digital Equipment Corp., Maynard, MA 01754
15605	Cutler Hammer, Inc., Milwaukee, WI 53202
15782	Houston Instrument Corp., Bellaire, TX 77401
15037	Spruce Pine Mica Co., Spruce Pine, NC 28777
16179	Omni Spectra Mich Div., Farmington, MI 48024
16352	Computer Diode Corp., Lodi, NJ 07644
16636	Indiana General Corp., Oglesby, IL 61348
16758	Delco Electronic Div., GMC, Kokomo, IN 46901
16950	Precision Dynamics Corp., Burbank, CA 91504
16952	American Micro Devices, Inc., Summerville, SC 29483
17117	Electronic Molding Corp., Woonsocket, RI 02895
17721	Singer Co., Diehl Div., Somerville, NJ 08876
17850	Zeltex, Inc., Concord, CA 94520
17856	Siliconix, Inc., Santa Clara, CA 95054
18324	Signetics, Corp., Sunnyvale, CA 94086
18542	New Product Engineering Inc., Wabash, IN 46992
18677	Scanbe Manufacturing Corp., El Monte, CA 91731
18736	Voltronics Corp., Hanover, NJ 07936
18736	Computer Diode Corp., S. Fairlawn, NJ 07936
19048	Computer Diode Corp., S. Fairlawn, NJ 07410
19178	Zero Manufacturing Co., Monson, MA 01057
19373	Eastron Corp., Haverhill, MA 01830
19396	Illinois Tool Works, Pakton Div., Chicago, IL 60634
19617	Cabtron Corp., Chicago, IL 60622
19644	L.R.C. Electronics, Horseheads, NY 14845
19701	Electra Mfg. Co., Independence, KS 67301
20764	K.M.C. Semiconductor, Long Valley, NJ 07853
21335	Fafnir Bearing Co., New Britain, CT 06050
21759	Lenox-Fugle Electronics, Watchung, NJ 07060
22753	UID Electronics Div., AMF Inc., Hollywood, FL 33022
23338	Wavetek Div., John Fluke, San Diego, CA 92112
23342	Avnet Electronics Corp., Franklin Park, IL 60131
24355	Analog Devices, Cambridge, MA 02142
24446	General Electric, Schenectady, NY 12305
24454	General Electric Electronics Comp., Syracuse, NY 13201
24455	General Electric Lamp Div., Cleveland, OH 44112
24602	E.M.C. Technology, Cherry Hill, NJ 08034
24655	General Radio Co., Concord, MA 01742
25289	E. G. & G. Inc., Bedford, MA 01730
26806	American Zettler, Inc., Costa Mesa, CA 92626
28480	Hewlett Packard, Palo Alto, CA 04304
28520	Heyman Mfg. Co., Kenilworth, NJ 07033
28959	Hoffman Electronics Corp., El Monte, CA 91734
30646	Beckman Instruments, Inc., Cedar Grove, NJ 07009
30874	I.B.M., Armonk, NY 10504
32001	Jensen Mfg. Co., Chicago, IL 60638
33173	General Electric Comp., Owensboro, KY 42301
34141	Koehler Mfg. Co., Inc., Marlboro, MA 01752
35929	Constanta, Co., Montreal Quebec
37942	P. R. Mallory & Co., Inc., Indianapolis, IN 46206
38443	Marlin-Rockwell Corp., Jamestown, NY 14701
39317	McGill Manufacturing Co., Inc., Valparaiso, IN 46383
40931	Honeywell, Inc., Minneapolis, MN 55408
42190	Muter Co., Chicago, IL 60638
42498	National Co., Inc., Melrose, MA 02176
43991	Norma Hoffman, Stanford, CT 06904
49671	R. C.A., New York, NY 10020
49956	Raytheon Mfg. Co., Waltham, MA 02154
50088	Mostek, Carrollton, TX 75006
53021	Sangamo Electric Co., Springfield, IL 62705
54294	Shallcross Mfg. Co., Selma, NC 27576
54715	Shure Brothers, Inc., Evanston, IL 60202
56289	Sprague Electric Co., North Adams, MA 01247
59730	Thomas & Betts Co., Elizabeth, NJ 07207
59875	T.R.W. Inc., (Accessories Div), Cleveland, OH 44117
60399	Torrington Mfg. Co., Torrington, CT 06790
61637	Union Carbide Corp., New York, NY 10017
61864	United-Carr Fastener Corp., Boston, MA 02142
63060	Victoreen Instrument Co., Cleveland, OH 44104
63743	Ward Leonard Electric, Mt. Vernon, NY 10550
65083	Westinghouse (Lamp Div), Bloomfield, NJ 07003
65092	Weston Instruments, Newark, NJ 07114
70106	Acushnet Capacitor Co., New Bedford, MA 02742
70109	Adams and Westlake Co., Elkhart, IN 46514
70485	Atlantic India Rubber Works, Inc., Chicago, IL 60607
70563	Amperite Co., Union City, NJ 07087
70903	Belden Mfg. Co., Chicago, IL 60644
71126	Bronson Homer D., Beacon Falls, CT 06403
71279	Cambridge Thermionic, Corp., Cambridge, MA 02138
71294	Canfield Co., Clifton Forge, VA 24422
71400	Bussmann Mfg. Co., St. Louis, MO 63107
71450	CTS Corp., Elkhart, IN 46514
71468	ITT-Cannon Electric Inc., Los Angeles, CA 90031
71482	C.P. Clare & Co., Chicago, IL 60645
71590	Centralab, Inc., Milwaukee, WI 53212
71666	Continental Carbon Co., Inc., New York, NY 10001
71707	Coto Coil Co., Inc., Providence, RI 02905
71729	Crescent Box Corp., E. Philadelphia, PA 19134
71744	Chicago Miniature Lamp., Chicago, IL 60640
71785	Cinch Jones, Chicago, IL 60624
71823	Darnell Corp., Ltd., Downey, CA 90241
72136	Electromotive Mfg. Co., Willimantic, CT 06226
72228	Continental Screw Co., New Bedford, MA 02742
72259	Nytronics, Inc., Berkeley Hts, NJ 07922
72619	Dialight Co., Brooklyn, NY 11237
72699	General Instrument Corp., Newark, NJ 07104
72765	Drake Mfg. Co., Chicago, IL 60631
72794	Dzus Fastener Co., Inc., West Islip, NY 11795
72825	Eby Co., Hugh H, Philadelphia, PA 19144
72962	Elastic Stop Nut Corp., Union, NJ 07083
72982	Erie Technological Products, Erie, PA 16512
73445	Amperex Electronic Corp., Hicksville, LI, NY 11801
73559	Carling Electric Co., W. Hartford, CT 06110
73690	Elco Resistor Co., New York, NY 10001
73899	J.F.D. Electronics Corp., Brooklyn, NY 11219
73957	Groov-Pin Corp., Ridgefield, NJ 07657
74193	Heinemann Electric Co., Trenton, NJ 08602
74545	Hubbell, Stratford, CT 06497
74861	Industrial Condenser Corp., Chicago, IL 60618
74868	Amphenol RF Division, Danbury, CT 06810
74970	Johnson Co., E.F., Waseca, MN 56093
75042	IRC Div. of TRW, Burlington, IA 52601
75382	Kulka Electric Corp., Mt. Vernon, NY 10551
75491	Lafayette Industrial Electronics, Syosset, NY 11791
75608	Linden & Co., Providence, RI 02905
75915	Littelfuse, Inc., Des Plaines, IL 60016
76005	Lord Mfg. Co., Erie, PA 16512
76149	Mallory Electric Corp., Detroit, MI 48204
76381	Minnesota Mining., St. Paul, MN 55101
76487	Millen Mfg. Co., Inc., Malden, MA 02148
76545	Mueller Electric Co., Cleveland, OH 44114
76684	National Tube Co., Pittsburg, PA 15230
76854	Oak Mfg. Co., Crystal Lake, IL 60014
77147	Patton MacGuyer Co., Providence, RI 02905
77166	Pas-Seymour, Syracuse, NY 13209
77263	Pierce-Roberts Rubber Co., Trenton, NJ 08638
77339	Positive Lockwasher Co., Newark, NJ 07101
77342	American Machine & Foundry Co., Princeton, IN 47570
77642	Ray-O-Vac Co., Madison, WI 53703
77630	T.R.W. Electronic Comp., Camden, NJ 08103
77638	General Instruments Corp., Brooklyn, NY 11211
78189	Shakeproof (Ill. Tool Wks), Elgin, IL 60120
78277	Sigma Instruments Inc., South Braintree, MA 02184
78488	Stackpole Carbon Co., St. Mary's, PA 15827
78553	Tinnerman Products, Inc., Cleveland, OH 44101
79089	R.C.A. Rec. Tube & Semicond., Harrison, NJ 07029
79136	Waldes Kohinoor Co., New York, NY 11101
79725	Wiremold Co., Hartford, CT 06110
79727	Continental WIRT Electronics Corp., Philadelphia, PA 19101
79963	Zierick Mfg. Co., Mount Kisco, NY 10549
80009	Tektronix, Inc., Beaverton, OR 97005
80030	Prestole Fastener, Toledo, OH 43605
80048	Vickers Inc., St. Louis, MO 63166
80103	Lambda Electronics Corp., Melville, NY 11746
80183	Sprague Products Co., North Adams, MA 01247
80211	Motorola Inc., Franklin Park, IL 60131
80251	Formica Corp., Cincinnati, OH 45232
80258	Standard Oil Co., Lafeyette, IN 47902
80294	Bourns Laboratories, Inc., Riverside, CA 92506
80368	Sylvania Electric Products, Inc., New York, NY 10017
80431	Air Filter Corp., Milwaukee, WI 53218
80583	Hammarlund Co., Inc., New York, NY 10010
80894	Pure Carbon Co., St. Mary's, PA 15857
81030	International Instrument, Orange, CT 06477
81073	Grayhill Inc., LaGrange, IL 60525
81143	Isolantite Mfg. Corp., Stirling, NJ 07980
81312	Winchester Electronics Co., Inc., Oakville, CT 06779
81349	Military Specifications
81350	Joint Army-Navy Specifications
81483	International Rectifier Corp., El Segundo, CA 90245
81751	Columbus Electronics Corp., Yonkers, NY 10701
81831	Filtron Co., Flushing, NY 11354
81860	Barry Wright Corp., Watertown, MA 02172
82219	Sylvania Elec. Prod., Emporium, PA 15834
82273	Indiana Pattern & Model Works, LaPort, IN 46350
82389	Switchcraft, Inc., Chicago, IL 60630
82647	Metals & Controls, Inc., Attleboro, MA 02703
82807	Milwaukee Resistor Co., Milwaukee, WI 53204
82877	Rotron Mfg. Co., Inc., Woodstock, NY 12498
83003	Varo Semiconductor Div., Garland, TX 75040
83033	Meissner Mfg., Mt. Carmel, IL 62863
83058	Carr Fastener Co., Cambridge, MA 02142
83186	Victory Engineering, Springfield, NJ 07081
83361	Bearing Specialty Co., San Francisco, CA 94101
83587	Solar Electric Corp., Warren, PA 16365
83594	Burroughs Corp., Plainfield, NJ 07061
83740	Union Carbide Corp., New York, NY 10017
84411	TRW Capacitor Division, Ogallala, NB 69153
84835	Lehigh Metal Products, Cambridge, MA 02140
84970	Sarkes Tarzian, Inc., Bloomington, IN 47401
84971	T.A. Mfg. Corp., Los Angeles, CA 90039
86577	Precision Metal Products, Stoneham, MA 02180
86684	R.C.A. (Elec. Comp. & Dev), Harrison, NJ 07029
86687	R.E. C. Corp., New Rochelle, NY 10801
86800	Cont. Electronics Corp., Brooklyn, NY 11222
88140	Cutler-Hammer Inc., Lincoln, IL 62656
88219	Gould Nat. Batteries, Inc., Trenton, NJ 08607
88419	Cornell Dubilier, Fuquay-Varina, NC 27526
88627	K & G Mfg. Co., New York, NY 10001
89482	Holtzer Cabot Corp., Boston, MA 02119
89665	United Transformer Co., Chicago, IL 60607
89870	Berkshire Transformer Corp., Kent, CT 06757
90201	Mallory Capacitor Co., Indianapolis, IN 46206
90303	Mallory Battery Co., Tarrytown, NY 10591
90634	Gulton Industries, Inc., Metuchen, NJ 08840
90750	Westinghouse Electric Corp., Boston, MA 02118
90952	Hardware Products Co., Reading, PA 19602
91032	Continental Wire Corp., York, PA 17405
91146	I.T.T. (Cannon), Salem, MA 01970
91210	Gerber Mfg. Co., Mishawaka, IN 46544
91293	Johanson Mfg. Co., Boonton, NJ 07005
91417	Harris Semiconductor, Melbourne, FL 32901
91506	Augat Brothers, Inc., Attleboro, MA 02703
91598	Chandler Co., Wethersfield, CT 06109
91637	Dale Electronics, Inc., Columbus, NE 68601
91662	Elco Corp., Willow Grove, PA 19090
91719	General Instruments Corp., Dallas, TX 75220
91836	Kings Electronics, Co., Inc., Tuckahoe, NY 11223
91916	Mephisto Tool Co., Inc., Hudson, NY 12534
91929	Honeywell, Inc., Freeport, IL 61032
92519	Electra Insul. Corp., Woodside, LI., NY 11377
92678	Edgerton Germeshuasen, Georgetown, MA 01830
92702	I.M.C. Magnetics Corp., Westbury, NY 11591
92739	Ampex Corp., Redwood City, CA 94063
92966	Hudson Lamp Co., Kearny, NJ 07032
93332	Sylvania Elect. Prods., Inc., Woburn, MA 01801
93618	R & C Mfg. Co. of Penn, Inc., Ramsey, PA 16671
93916	Cramer Products Co., New York, NY 10013
94144	Raytheon Co., Components Div., Quincy, MA 02169
94154	Tung Sol Electric Inc., Newark, NJ 07101
94271	Weston Instruments, Inc., Archibald, PA 18403
94322	Tel Labs, Manchester, NH 03102
94589	Dickson Co., Chicago, IL 60619
94696	Magnecraft Electric Co., Chicago, IL 60630
94800	Atlas Industrial Corp., Brookline, NH 03033
95076	Garde Mfg. Co., Cumberland, RI 02864
95121	Quality Components, Inc., St. Marys, PA 15857
95146	Alco Electronics Mfg. Co., Lawrence, MA 01843
95238	Continental Connector Corp., Woodside, NY 11377
95275	Vitramon, Inc., Bridgeport, CT 06601
95348	Gordos Corp., Bloomfield, NJ 07003
95354	Methode Mfg. Co., Rolling Meadow, IL 60008
95794	American Brass Co., Torrington, CT 06790
95987	Weckesser Co., Inc., Chicago, IL 60646
96095	Hi Q Division of Aerovox Corp., Olean, NY 14760
96341	Microwave Associates, Inc., Burlington, MA 01801
96906	Military Standards,
98291	Sealectro Corp., Mamaroneck, NY 10544
98474	Compar, Inc., Burlingame, CA 94010
98821	North Hills Electronic, Glen Cove, NY 11542
99117	Metavac, Inc., Flushing, NY 11358
99313	Varian Associates, Palo Alto, CA 94303
99378	Atlee Corp., Winchester, MA 01890
99800	Delevan Electronics, East Aurora, NY 14052

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ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.
CHASSIS MOUNTED ELECTRICAL PARTS				
LAMP				
XDS1 and XDS2	28-V Pilot light	5600-1060	24454	#328
CONNECTORS				
J7	BNC panel jack asm	1169-2405	24655	1169-2405
J8	50 pin jack	42304049	93916	57-40500
J9	Coaxial asm	1169-2869	24655	1169-2869
RESISTORS				
R1	Pot. comp., 10 k ohms, ±10%	6000-0600	00912	JV, 10 k ohms, ±10%
R2	Pot. wire wound, 1 k ohm, ±10%	6060-0250	05706	1 k ohm, ±10%
R3	Pot. comp., 10 k ohms, ±10% SWK	6045-0400	01121	GA, 10 kohms, ±10%
R4	Comp., 18 k ohms, ±5%, 1/4 W	6099-3185	01121	RC07GF-183J
R5	Pot. cermet, 20 k ohms, ±10%	6049-0299	80294	3329W, 20 k ohms, ±10%
R6	Pot. wire wound, 1 k ohm, ±5%	6060-0232	80294	3305P, 1 k ohm, ±5%
SWITCHES				
S1	Rotary Wafer	7890-5326	76845	7890-5326
S2	Asm	1165-2324	24655	1165-2324
S3 thru S10	Asm	1165-2325	24655	1165-2325
S11	Part of R3 Asm			
S12	Part of R2 Asm			
S14	Push Button, Multiple, 9	7880-2011	24655	7880-2011

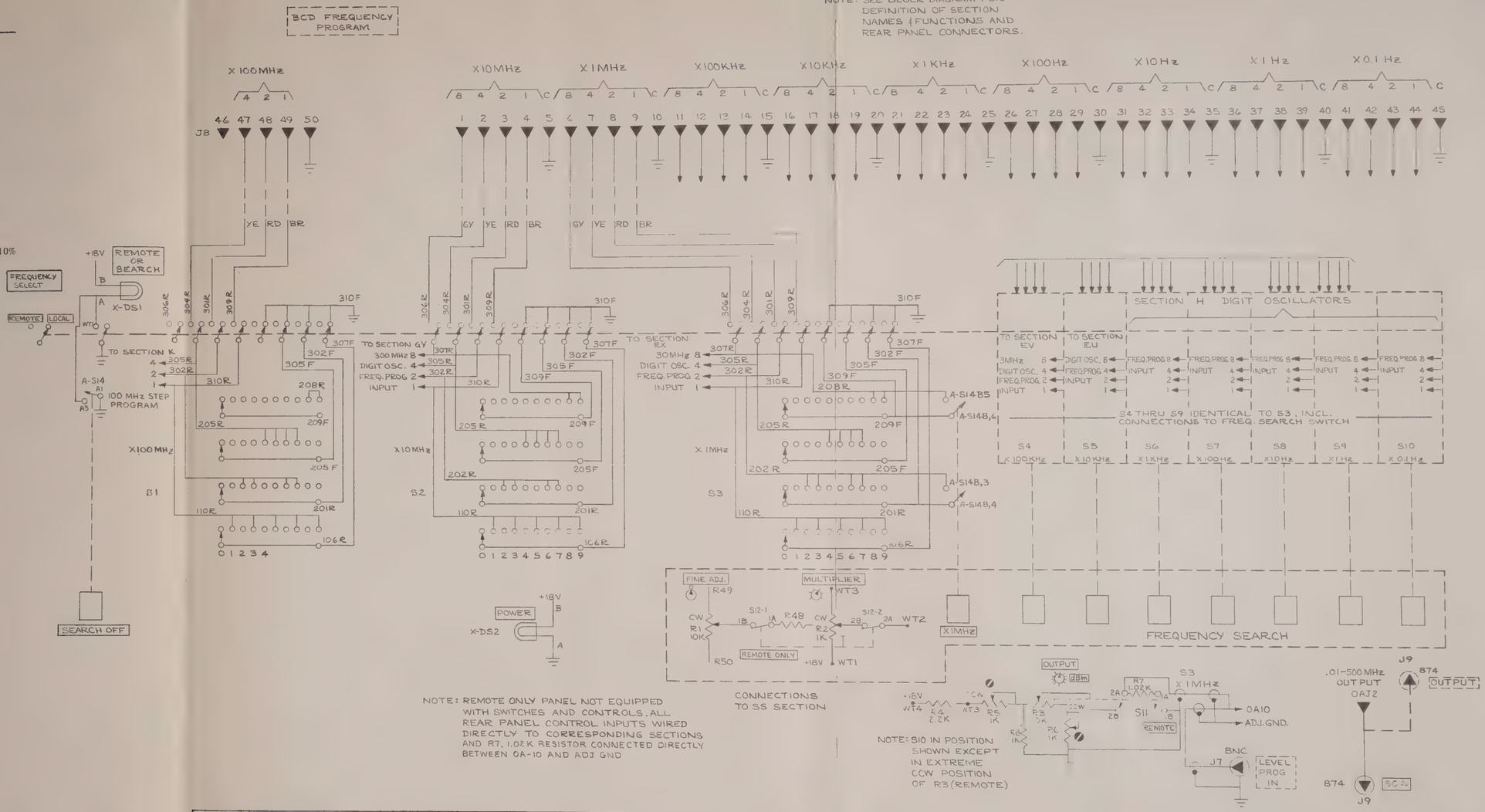


Figure 6-6. Schematic diagram — panel circuit.

ELECTRICAL PARTS LIST

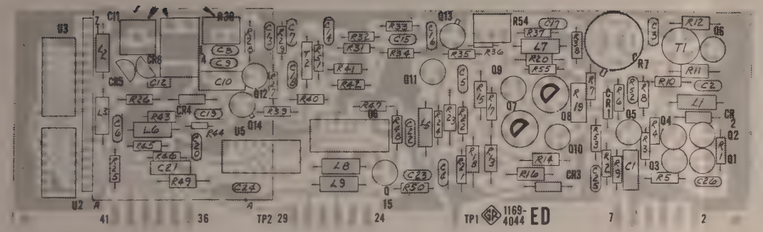
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4044 DIGIT OSCILLATOR BOARD (ED)					
CAPACITORS					
C1	Cer., 1.0 uF ±20% 50 V	4400-2070	72982	8131, 1.0 uF, ±20%	
C2	Cer., .01 uF, +80-20% 100 V	4401-3100	80131	CC61, .01 uF +80-20%	5910-974-5697
C3	Cer., 330 pF ±10% 500 V	4404-1338	72982	831, 330 pF ±10%	5910-974-5702
C4	Cer., 330 pF ±5% 500 V	4404-1335	72982	0831082Z5D00331J	
C5	Cer., 2200 pF ±10% 500 V	4405-2228	72982	801, 2200 pF ±10%	
C6 and C7	Cer., .01 uF +80-20% 100 V	4401-3100	80131	CC61, .01 uF +80-20%	5910-974-5697
C8	Cer., 24 pF ±5%, 100 V, N330	4415-1003	72982	811, 24 pF ±5%	
C9	Cer., 22 pF, ±5%, 100 V, N330	4415-1002	72982	811, 22 pF, ±5%	
C10	Mica, 180 pF ±5%, 500 V	4700-0650	14655	22A, 180 pF ±5%	
C11	Trimmer, 2-8 pF, 350 V, NPO	4910-2033	72982	538-000, 2-8 pF	
C12	Cer., .047 uF ±20%, 50 V	4400-2040	72982	8121, .047 uF, ±20%	
C13 thru C16	Cer., 1000 pF ±10%, 500 V	4405-2108	72982	811, 1000 pF ±10%	5910-914-0087
C17	Cer., 47 pF ±5%, 500 V	4404-0475	72982	831, 47 pF ±5%	
C18 and C19	Cer., 1000 pF ±10% 500 V	4405-2108	72982	811, 1000 pF ±10%	5910-914-0087
C20	Cer., 68 pF ±5% 500 V	4404-0685	72982	831, 68 pF ±5%	
C21	Cer., 1.0 uF, ±20%, 50 V	4400-2070	72982	8131, 1.0 uF, ±20%	
C22	Cer., .01 uF +80-20% 100 V	4401-3100	80131	CC61, .01 uF +80-20%	5910-974-5697
C23	Cer., 120 pF ±5% 500 V	4404-1125	72982	831, 120 pF ±5%	
C24	Cer., 430 pF, ±5%, 500 V	4700-0549	14655	22A, 430 pF ±5%	
C25 and C26	Cer., .01 uF +80-20% 100 V	4401-3100	80131	CC61, .01 uF +80-20%	5910-974-5697
DIODES					
CR1 thru CR4	Type 1N3604	6082-1001	24446	1N3604	5961-995-2199
CR5 and CR6	Type MV2111	6084-1031	04713	MV2111	
CR7	Type CA3039	6082-1044	02735	CA3039	
INDUCTORS					
L1	Molded, 6.8 uH, ±10%	4300-1900	99800	1537-30, 6.8 uH, ±10%	
L2 and L3	Molded, 3.9 uH, ±10%	4300-1500		1537-26, 3.9 uH, ±10%	
L4	Asm, (RD)	1169-2412	24655	1169-2412	
L5	Molded, 22.0 uH, ±10%	4300-2600	99800	1537-22, 22.0 uH, ±10%	5950-951-9266
L6	Molded, 1.0 uH, ±10%	4300-0700	99800	1537, 1 uH, ±10%	5950-683-7984
L7	Molded, 0.47 uH, ±20%	4300-0400	99800	1537, .47 uH, ±20%	5950-135-6007
L8	Molded, 18.0 uH, ±10%	4300-2500	99800	1537-42, 18.0 uH, ±10%	
L9	Molded, 4.7 uH, ±10%	4300-1600	99800	1537-28, 4.7 uH, ±10%	
L10 and L11	Ferrite Bead Asm	5000-1250	02114	56-590-65/4B	
INTEGRATED CIRCUITS					
U2	Digital Type SN74L00N	5431-8300	96214	SN74L00N	
U3	Digital Type SN7445N	5431-8145	96214	SN7445N	
U5 and U6	Digital Type MC1032P	5431-9620	04713	MC1032P	

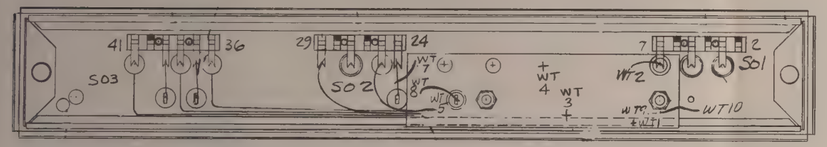
ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
RESISTORS					
R1	Comp., 1 k ohm, ±5%, 1/4 W	6099-2105	01121	RC07GF-102J	5905-681-6422
R2	Comp., 2 k ohms, ±5%, 1/4 W	6099-2205	01121	RC07GF-202J	5905-686-3370
R3 and R4	Comp., 1.2 k ohms, ±5%, 1/4 W	6099-2125	01121	RC07GF-122J	
R5	Comp., 100 ohms, ±5%, 1/4 W	6099-1105	01121	RC07GF-101J	
R6	Comp., 390 ohms, ±5%, 1/4 W	6099-1395	01121	RC07GF-391J	
R7	Comp., 1.8 k ohms, ±5%, 1/4 W	6099-2185	01121	RC07GF-182J	5905-688-3738
R8	Comp., 220 ohms, ±5%, 1/4 W	6099-1225	01121	RC07GF-221J	5905-683-2240
R9	Comp., 15 ohms, ±5%, 1/4 W	6099-0155	01121	RC07GF-150J	
R10	Comp., 51 ohms, ±5%, 1/4 W	6099-0515	01121	RC07GF-510J	
R11 and R12	Film, 49.9 ohms, ±1%, 1/8 W	6250-9499	75042	CEA, 49.9 ohms, ±1%	5905-800-7815
R13	Film, 14.7 k ohms, ±1%, 1/8 W	6250-2147	75042	CEA, 14.7 k ohms, ±1%	5905-702-1143
R14 and R15	Film, 6.34 k ohms, ±1%, 1/8 W	6250-1634	75042	CEA, 6.34 k ohms, ±1%	
R16	Film, 432 ohms, ±1%, 1/8 W	6250-0432	75042	CEA, 432 ohms, ±1%	5905-577-7782
R17	Comp., 4.7 k ohms, ±5%, 1/4 W	6099-2475	01121	RC07GF-472J	5905-686-9992
R18	Film, 4.99 k ohms, ±1%, 1/8 W	6250-1499	75042	CEA, 4.99 k ohms, ±1%	
R19	Film, 10 k ohms, ±1%, 1/8 W	6250-2100	75042	CEA, 10 k ohms, ±1%	5905-883-4847
R20	Film, 67.3 ohms, ±1%, 1/8 W	6250-9673	75042	CEA, 67.3 ohms, ±1%	
R21	Comp., 8.2 k ohms, ±5%, 1/4 W	6099-2825	01121	RC07GF-202J	
R22	Comp., 2 k ohms, ±5%, 1/4 W	6099-2205	01121	RC07GF-202J	5905-686-3370
R23	Comp., 2 k ohms, ±5%, 1/2 W	6100-2205	01121	RC20GF-202J	5905-190-8887
R24	Comp., 330 ohms, ±5%, 1/4 W	6099-1335	01121	RC07GF-331J	5905-686-3369
R25	Comp., 12 ohms, ±5%, 1/4 W	6099-0125	01121	RC07GF-120J	5905-806-0633
R26	Comp., 33 k ohms, ±5%, 1/4 W	6099-3335	01121	RC07GF-333J	
R27	Comp., 24 k ohms, ±5%, 1/4 W	6099-3245	01121	RC07GF-342J	
R28	Comp., 3.9 k ohms, ±5%, 1/4 W	6099-2395	01121	RC07GF-392J	
R29	Comp., 1 k ohm, ±5%, 1/4 W	6099-2105	01121	RC07GF-102J	5905-681-6422
R30	Pot., cermet, 500 ohms, ±20%	6049-0313	24655	6049-0313	
R31	Comp., 100 ohms, ±5%, 1/4 W	6099-1105	01121	RC07GF-101J	
R32	Comp., 39 ohms, ±5%, 1/4 W	6099-0395	01121	RC07GF-390J	5905-686-9997
R33	Comp., 680 ohms, ±5%, 1/4 W	6099-1685	01121	RC07GF-681J	
R34	Comp., 6.8 k ohms, ±5%, 1/4 W	6099-2685	01121	RC07GF-682J	5905-686-9997
R35	Comp., 4.7 k ohms, ±5%, 1/4 W	6099-2475	01121	RC07GF-472J	5905-686-9992
R36	Comp., 15 ohms, ±5%, 1/8 W	6098-0155	01121	RC07GF-150J	
R37	Comp., 330 ohms, ±5%, 1/4 W	6099-1335	01121	RC07GF-331J	5905-686-3369
R38	Comp., 51 ohms, ±5%, 1/4 W	6099-0515	01121	RC07GF-510J	
R39	Comp., 27 ohms, ±5%, 1/4 W	6099-0275	01121	RC07GF-270J	
R40	Comp., 680 ohms, ±5%, 1/4 W	6099-1685	01121	RC07GF-681J	
R41	Comp., 4.7 k ohms, ±5%, 1/4 W	6099-2475	01121	RC07GF-472J	5905-686-9992
R42	Comp., 6.8 k ohms, ±5%, 1/4 W	6099-2685	01121	RC07GF-682J	5905-686-9997
R43	Comp., 150 ohms, ±5%, 1/4 W	6099-1155	01121	RC07GF-151J	5905-195-9481
R44	Comp., 15 ohms, ±5%, 1/8 W	6098-0155	01121	RC05GF-150J	
R45	Comp., 3.9 k ohms, ±5%, 1/4 W	6099-2395	01121	RC07GF-392J	
R46	Comp., 1 k ohm, ±5% 1/4 W	6099-2105	01121	RC07GF-102J	5905-681-6422
R47	Comp., 180 ohms, ±5%, 1/4 W	6099-1185	01121	RC07GF-181J	5905-682-4107
R48	Comp., 47 ohms, ±5%, 1/4 W	6099-0475	01121	RC07GF-470J	
R49	Comp., 7.5 ohms, ±5%, 1/2 W	6100-9755	01121	RC20GF-7R5	
R50	Comp., 430 ohms, ±5%, 1/4 W	6099-1435	01121	RC07GF-431J	
R51	Comp., 750 ohms, ±5%, 1/4 W	6099-1755	01121	RC20GF-751J	5905-195-9481
R52	Therm 200 ohms, ±10%	6740-1600	02606	KB22J1	
R53	Comp., 2 k ohms, ±5%, 1/4 W	6099-2205	01121	RC07GF-202J	5905-686-3370
R54	Pot. cermet, 100 k ohms, ±20%	6049-0321	24655	RC06049-0321	
R55	Comp., 33 k ohms, ±5%, 1/4 W	6099-3335	01121	RC07GF-333J	
RESISTOR NETWORK					
Z1	Thin Film	1169-0810	24655	1169-0810	

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
TRANSFORMER ASM					
T1	BR	1169-2415	24655	1169-2415	
T2	Asm	1160-2614	24655	1160-2614	
TRANSISTORS					
Q1 and Q2	Type 2N4275	8210-1126	07263	2N4275	
Q3 thru Q5	Type 2N4258	8210-1136	07263	2N4258	
Q6	Type 2N4275	8210-1203	07263	2N4275	
Q7 and Q8	Type TD-400	8210-1169	56289	TD-400	
Q9 thru Q11	Type 2N3391A	8210-1092	24454	2N3391A	
Q12	Type 2N3563	8210-1066	07263	2N3563	
Q13 and Q14	Type 2N5180	8210-1189	34156	2N5180	
Q15	Type 2N4258	8210-1136	07263	2N4258	
1169-2023 ENCLOSURE BASE (EU)					
CAPACITORS					
EU-C1 thru EU-C9	Feedthru, 1000 pF, +100-0% 500 V	4400-2200	01121	FA5C, 1000 pF, +100-0%	
CONNECTORS					
EU-J1 thru EU-J3	R-f insert	1165-6020	24655	1165-6020	
S01	Contact strip Asm.	1165-1830	24655	1165-1830	
S02	Contact Strip Asm.	1165-1942	24655	1165-1942	
S03	Contact Strip Asm.	1165-1853	24655	1165-1853	
INDUCTORS					
EU-L1	Molded, 10 uH ±10%	4300-6500	99800	2150, 10 uH, ±10%	
EU-L2	Molded, 22 uH ±10%	4300-2600	99800	1537, 22 uH, ±10%	5950-951-9266





Etched-circuit diagram, Digit Oscillator Board – ED (P/N 1169-4044).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is not shown. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

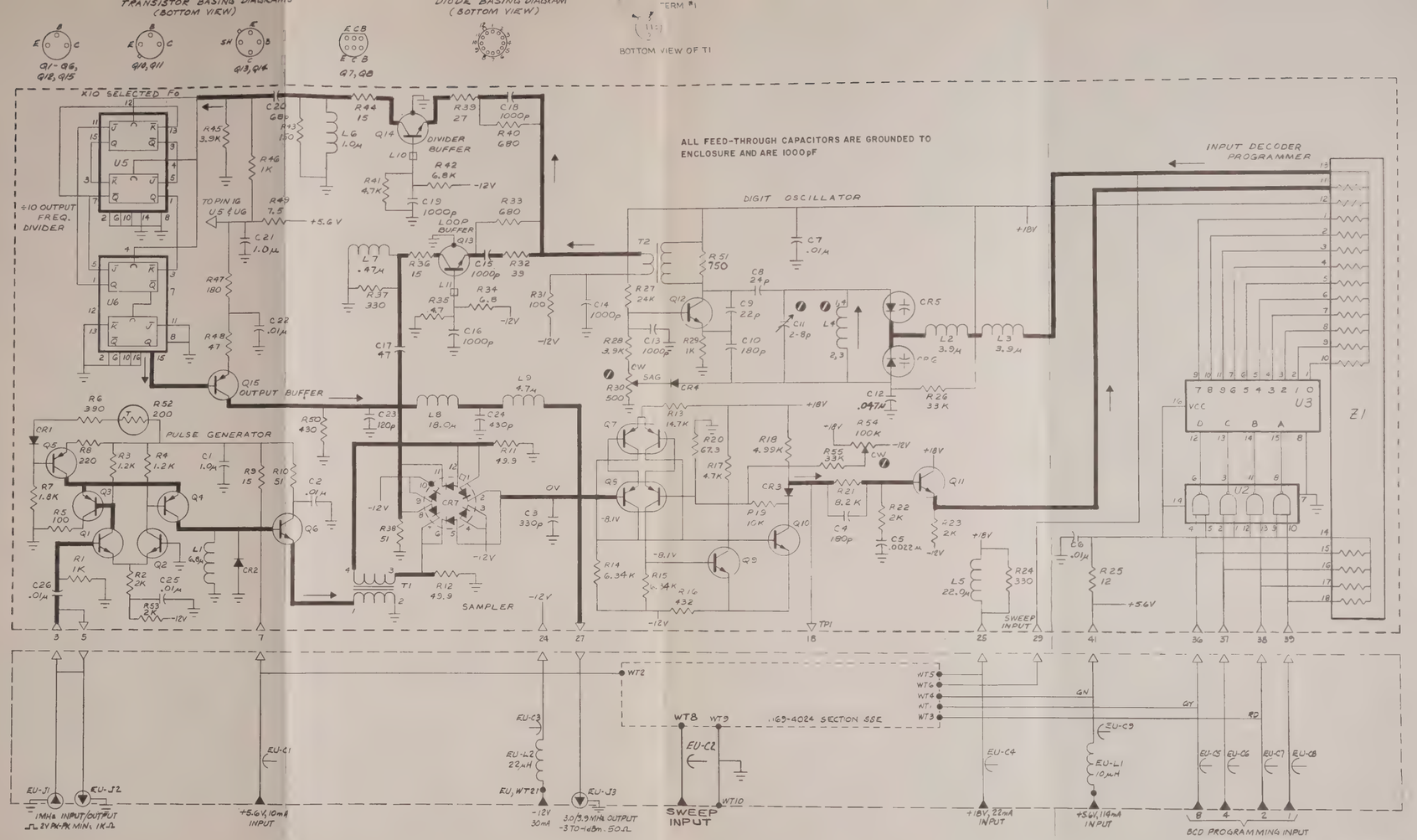
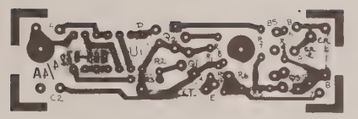


Figure 6-7. 3-MHz digit oscillator – ED (P/N 1169-4044).

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4024 SEARCH/SWEEP ENABLE BOARD (SSE)					
DIODES					
CR1 and CR2	Type BA136A	6082-1035	25088	BA136A	
INTEGRATED CIRCUITS					
U1	Digital Type SN74L00N	5431-8300	96214	SN74L00N	
INDUCTORS					
L1	Molded, 220 uH, ±10%	4300-7556	72259	1025, 220 uH, ±10%	
RESISTORS					
R1	Comp., 3.3 k ohms, ±5% 1/8 W	6098-2335	01121	BB, 3.3 k ohms, ±5%	
R2	Comp., 2 k ohms, ±5% 1/8 W	6098-2205	01121	BB, 2 k ohms, ±5%	
R3	Comp., 3.3 k ohms, ±5% 1/8 W	6098-2335	01121	BB, 3.3 k ohms, ±5%	
R4	Comp., 56 k ohms, ±5% 1/8 W	6098-3565	01121	BB, 56 k ohms, ±5%	
R5	Comp., 5.6 k ohms, ±5% 1/8 W	6098-2565	01121	BB, 5.6 k ohms, ±5%	
R6	Comp., 680 ohms, ±5%, 1/4 W	6099-1685	01121	RC07GF-681J	
R7	Comp., 2.2 k ohms, ±5% 1/8 W	6098-2225	01121	BB, 2.2 k ohms, ±5%	
R8	Comp., 27 k ohms, ±5% 1/8 W	6098-3275	01121	BB, 27 k ohms, ±5%	
R9	Comp., 56 k ohms, ±5%, 1/8 W	6098-3565	01121	BB, 56 k ohms, ±5%	
TRANSISTORS					
Q1 and Q2	Type 2N4125	8210-1125	04713	2N4125	
Q3	Type 2N2369	8210-1052	96214	2N2369	5960-682-7755

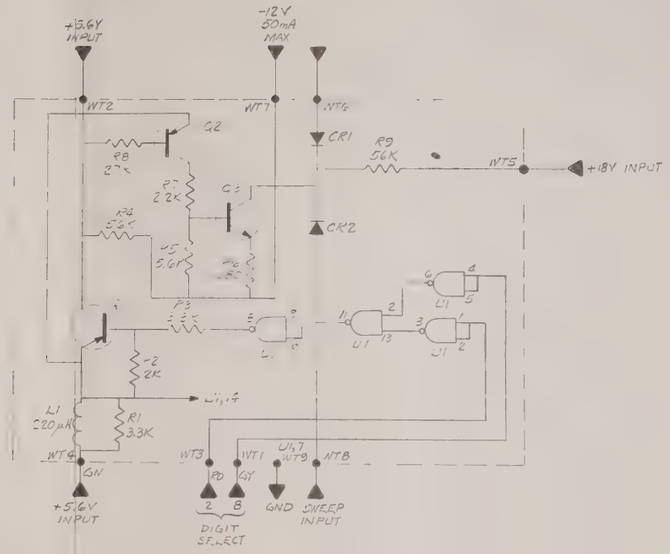


Etched-circuit diagram, Sweep enable-circuit SSE. (P/N 1169-4024)

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

COMPONENTS USED:

INDUCTOR : L1
RESISTORS: R1 THRU R9
TRANSISTORS: Q1, Q2, Q3
DIODES: CR1, CR2
INTEGRATED CIRCUIT: U1



RESISTANCE IS IN OHMS, K=10^3, M=10^6
CAPACITANCE S IN FARADS, μ=10^{-6}, p=10^{-12}
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
——→ PANEL CONTROL - - - - → REAR CONTROL
⊘ SCREWDRIVER CONTROL WT=WIRE TIE TP=TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER, C-R1, B-R1, ETC

4 0 4 F SWITCH NUMBERING
FRONT, REAR
CONTACTS FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS 01
SECTION, SECTION NEAREST PANEL IS 1.
ROTORS SHOWN CCW

CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY

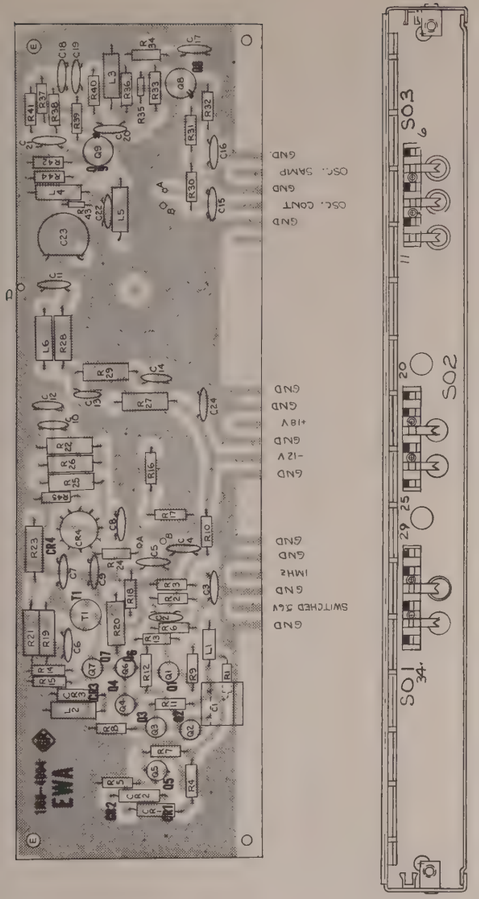
Figure 6-8. Sweep enable-circuit — SSE (P/N 1169-4024).

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4094 SAMPLER BOARD (EWA)					
CAPACITORS					
C1	Cer., 2.2 uF, ±20% 50 V	4400-2080	72982	8141, 2.2 uF, ±20%	
C2	Ceramic, 100 pF ±5% 500 V	4404-1105	72982	831, 100 pF ±5%	
C3 thru C8	Cer., .01 uF, +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C9	Cer., 120 pF ±10% 500 V	4404-1128	72982	831, 120 pF ±10%	
C10 thru C15	Cer., .01 uF, +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C16 and C17	Cer., 1000 pF ±10% 500 V	4405-2108	72982	831, 1000 pF ±10%	5910-914-0087
C18	Cer., .01 uF, +80-20% 100 V	4401-3100	80131	CC61, .01 uF +80-20%	5910-974-5697
C19	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C20	Cer., 56 pF ±5% 500 V	4404-0568	72982	831, 56 pF ±5%	
C21	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C22	Cer., 15 pF ±5% 500 V, N030	4411-0155	72982	801, 15 pF, ±5%	
C23	Cer., 43 pF ±5% 500 V N030	4411-0435	72982	801, 43 pF ±5%	
C24	Cer., .01 uF, +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
DIODES					
CR1 thru CR3	Type 1N3604	6082-1001	24446	1N3604	5961-995-2199
CR4	Type CA3039	6082-1044	02735	CA3039	
FILTERS					
RL1 and RL2	Ferrite bead	5000-1250	24655	5000-1250	
INDUCTORS					
L1	Molded, 220 uH ±10%	4300-7556	99800	1537-28, 220 uH ±10%	
L2	Molded, 6.8 uH ±10%	4300-1900	99800	1537-28, 6.8 uH ±10%	
L3	Molded, 0.47 uH ±10%	4300-0400	99800	1537, 47 uH ±10%	5950-135-6007
L4	Molded, 4.7 uH ±10%	4300-1600	99800	1537-28, 4.7 uH ±10%	
L5	Molded, 1.8 uH ±10%	4300-1100	99800	1537, 1.8 uH ±10%	
L6	Molded, 0.47 uH, ±20%	4300-0400	99800	1537, .47 uH ±20%	5950-135-6007
RESISTORS					
R1	Comp., 330 ohms, ±5% 1/4 W	6099-1335	01121	RC07GF-331J	5905-686-3369
R2	Comp., 51 ohms, ±5% 1/4 W	6099-0515	01121	RC07GF-510	
R3	Comp., 1 k ohm, ±5% 1/4 W	6099-2105	01121	RC07GF-102J	5905-681-6422
R4	Comp., 300 ohms, ±5% 1/4 W	6099-1305	01121	RC07GF-301J	5905-279-5481
R5	Comp., 1.8 k ohms, ±5% 1/4 W	6099-2185	01121	RC07GF-182J	5905-688-3733
R6	Comp., 20 k ohms, ±5% 1/4 W	6099-3205	01121	RC07GF-203J	5905-686-3368
R7	Comp., 150 ohms, ±5% 1/4 W	6099-1155	01121	RC07GF-151J	5905-683-2243
R8	Comp., 100 ohms, ±5% 1/4 W	6099-1105	01121	RC07GF-101J	
R9 and R10	Comp., 2.0 k ohms, ±5% 1/4 W	6099-2205	01121	RC07GF-202J	5905-686-3370
R11 and R12	Comp., 1.2 k ohms, ±5% 1/4 W	6099-2125	01121	RC07GF-122J	
R13	Comp., 51 ohms, ±5% 1/4 W	6099-0515	01121	RC07GF-510J	
R14	Comp., 470 ohms, ±5% 1/4 W	6099-1475	01121	RC07GF-471J	5905-683-2242

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
RESISTORS (cont)					
R15	Comp., 15 ohms, ±5% 1/4 W	6099-0155	01121	RC07GF-150J	
R16	Comp., 1 k ohm, ±5% 1/4 W	6099-2105	01121	RC07GF-102J	5905-681-6422
R17	Comp., 4.7 k ohms, ±5%, 1/4 W	6099-2475	01121	RC07GF-472J	5905-686-9992
R18	Comp., 1 k ohm, ±5% 1/4 W	6099-2105	01121	RC07GF-102J	5905-681-6422
R19 and R20	Film, 49.9 ohms, ±1% 1/8 W	6250-9499	75042	CEA, 49.9 ohms, ±1%	5905-800-7815
R21 and R22	Film, 1 k ohm, ±1% 1/8 W	6250-1100	75042	CEA, 1 k ohm, ±1%	5905-581-6915
R23	Film, 3.01 k ohms, ±1% 1/8 W	6250-1301	75042	CEA, 3.01 k ohms, ±1%	5905-702-5974
R24	Comp., 51 ohms, ±5% 1/4 W	6099-0515	01121	RC07GF-510J	
R25	Film, 1 k ohm, ±1% 1/8 W	6250-1100	75042	CEA, 1 k ohm, ±1%	5905-581-6915
R26	Film, 6.04 k ohms, ±1%, 1/8 W	6250-1604	75042	CEA, 6.04 k ohms, ±1%	5905-577-1790
R27 thru R29	Film, 1 k ohm, ±1%, 1/8 W	6250-1100	75042	CEA, 1 k ohm, ±1%	5905-581-6915
R30	Comp., 100 ohm, ±5% 1/4 W	6099-1105	01121	RC07GF-101J	
R31	Comp., 680 ohms, ±5% 1/4 W	6099-1685	01121	RC07GF-681J	
R32	Comp., 39 ohms, ±5% 1/4 W	6099-0395	01121	RC07GF-390J	
R33	Comp., 6.8 k ohms, ±5% 1/4 W	6099-2685	01121	RC07GF-682J	5905-686-9997
R34	Comp., 4.7 k ohms, ±5% 1/4 W	6099-2475	01121	RC07GF-472J	5905-686-9992
R35	Comp., 15 ohms, ±5% 1/8 W	6098-0155	01121	RC05GF-150J	
R36	Comp., 330 ohms, ±5%, 1/4 W	6099-1335	01121	RC07GF-331J	
R37	Comp., 100 ohms, ±5% 1/4 W	6099-1105	01121	RC07GF-101J	
R38	Comp., 220 ohms, ±5% 1/4 W	6099-1225	01121	RC07GF-221J	5905-683-2240
R39	Comp., 470 ohms, ±5% 1/4 W	6099-1475	01121	RC07GF-471J	5905-683-2242
R40	Comp., 39 ohms, ±5% 1/4 W	6099-0395	01121	RC07GF-390J	
R41	Comp., 5.6 k ohms, ±5% 1/4 W	6099-2565	01121	RC07GF-562J	5905-691-0195
R42	Comp., 4.7 k ohms, ±5% 1/4 W	6099-2475	01121	RC07GF-472J	5905-686-9992
R43	Comp., 15 ohms, ±5% 1/8 W	6098-0155	01121	RC05GF-150J	
R44	Comp., 1 k ohm, ±5% 1/4 W	6099-2105	01121	RC07GF-102J	5905-681-6422
R45	Comp., 51 ohms, ±5% 1/4 W	6099-0515	01121	RC07GF-510J	
TRANSFORMER					
T1	Interstage	1169-2415	24655	1169-2415	
TRANSISTORS					
Q1 and Q2	Type 2N4275	8210-1126	07263	2N4275	
Q3 thru Q5	Type 2N4258	8210-1136	07263	2N4258	
Q6 and Q7		8210-1203	24655	8210-1203	
Q8 and Q9	Type 2N5180	8210-1189	34156	2N5180	
1169-2650 ENCLOSURE BASE (EW)					
CAPACITORS					
EW-C1 thru EW-C3	Feedthru, 1000 pF +100-0% 500 V	4400-2200	01121	FA5C, 1000 pF, +100-0%	
CONNECTORS					
EW-J1 thru EW-J4	RF insert	1165-6020	24655	1165-6020	
S01 and S02	Contact strip	1165-1823	24655	1165-1823	
S03	Contact strip	1165-1830	24655	1165-1830	



Etched-Circuit diagram, Sampler board — EWA (P/N 1169-4094).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is not shown. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

RESISTANCE IS IN OHMS, K=10^3, M=10^6
CAPACITANCE IS IN FARADS, µ=10^{-6}, p=10^{-12}
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
⟵ PANEL CONTROL ⟶ REAR CONTROL
⊘ SCREWDRIVER CONTROL WT-WIRE TIE TP-TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER, C-A1, R-A1, ETC.

4 0 4 F — SWITCH NUMBERING
- FRONT, REAR
- CONTACTS, FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS .01
- SECTION, SECTION NEAREST PANEL IS 1.

ROTORS SHOWN CCW

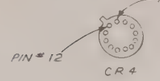
CONNECTIONS
- OUTPUT LEAVES SUBASSEMBLY
- INPUT FROM DIFFERENT SUBASSEMBLY
- OUTPUT REMAINS ON SUBASSEMBLY
- INPUT FROM SAME SUBASSEMBLY

NOTE POSITION OF "BUMP" ON SIDE WITH RESPECT TO TERM #1

BOTTOM VIEW OF T1

ALL FEED-THROUGH CAPACITORS ARE GROUNDED TO ENCLOSURE AND ARE 1000 pF

DIODE BASING (BOTTOM VIEW)



TRANSISTOR BASING (BOTTOM VIEW)

COMPONENTS USED:

RESISTORS: R1-R45
CAPACITORS: C1-C24
DIODES: CR1-CR4
TRANSISTORS: Q1-Q9
INDUCTORS: L1-L6
FERRITE BEADS: RL1, RL2
TRANSFORMER: T1

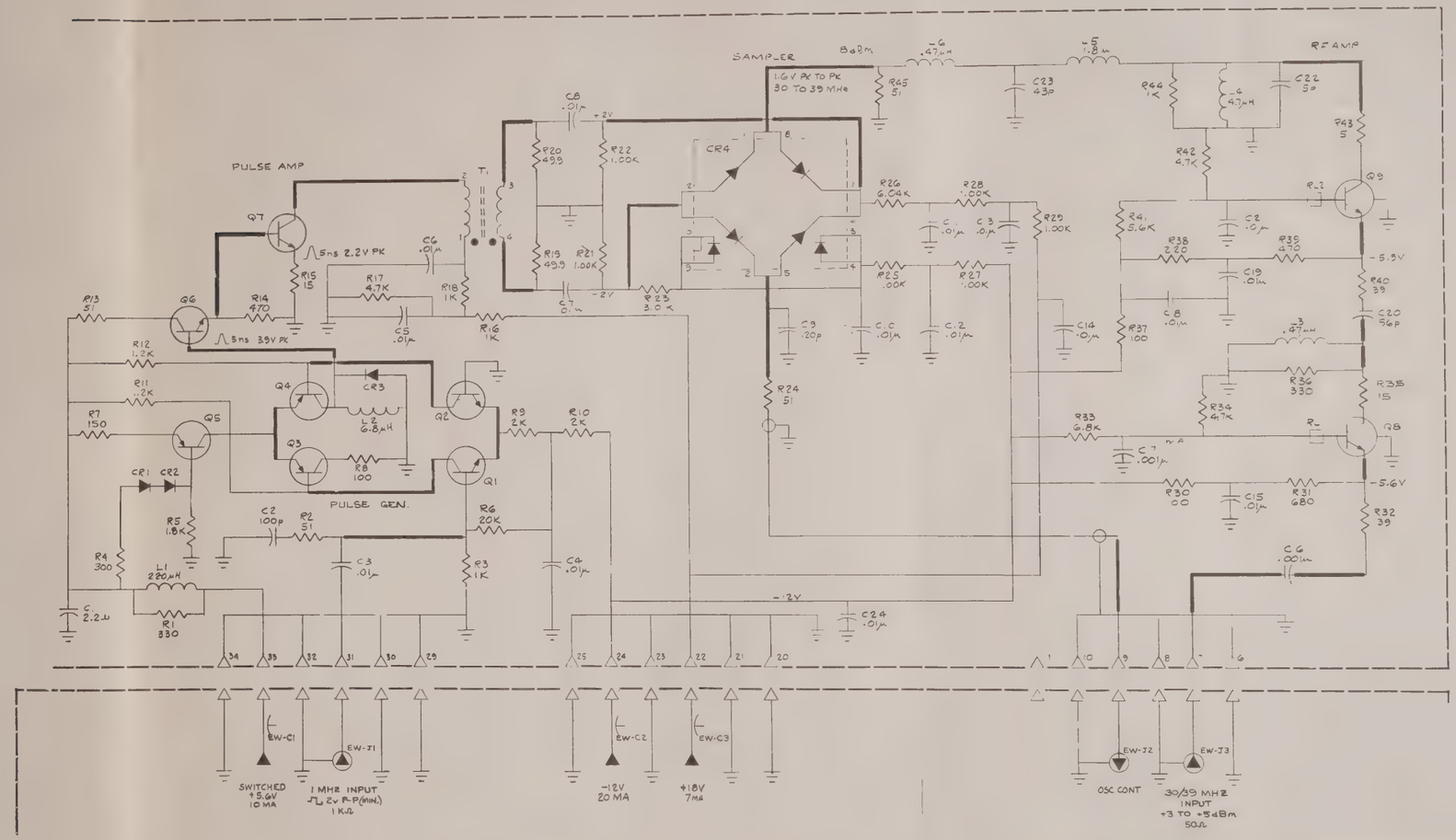


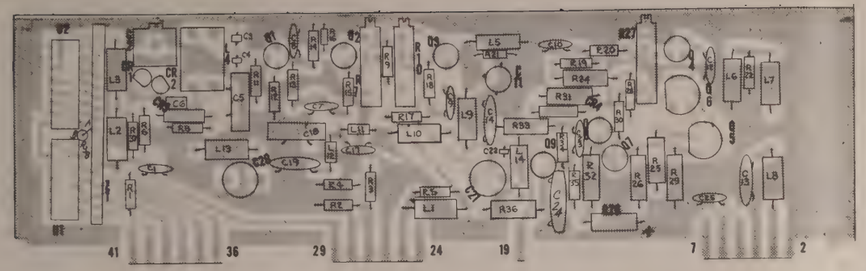
Figure 6-9. 30-MHz Digit-oscillator Sampler — EWA (P/N 1169-4094).

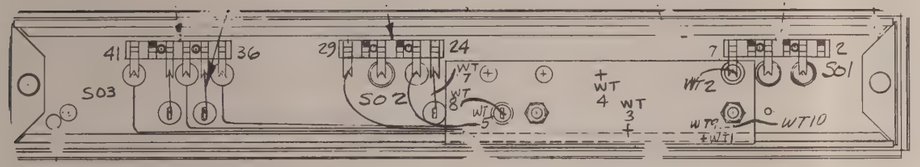
ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4096 OSCILLATOR BOARD (EXA)					
CAPACITORS					
C1	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C2	Trimmer, ceramic, 2-8 pF	4910-2033	72982	538-006, 2-8 pF	
C3	Cer., 18 pF ±5% 100 V N150	4417-2000	72982	801, 18 pF ±5%	
C4	Cer., 22 pF ±5% 100 V N750	4417-2001	72982	801, 22 pF ±5%	
C5	Mica, 180 pF ±5% 500 V	4700-0650	14655	22A, 180 pF ±5%	5910-055-1137
C6	Cer., .047 uF ±20% 50 V	4400-2040	72982	8121, .047 uF ±20%	
C7	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C8	Cer., 1000 pF ±5% 500 V	4405-2105	72982	801, 1000 pF ±5%	
C9 and					
C10	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5679
C11	Trimmer, ceramic, 3.5-13 pF	4910-2071	72982	7S-TR1K0-02, 3.5-13 pF	
C12	Cer., 15 pF ±5% 500 V N030	4411-0155	72982	801, 15 pF ±5%	
C13 and					
C14	Cer., 43 pF ±5% 500 V N030	4411-0435	72982	801, 43 pF ±5%	
C17	Cer., 10 pF ±5% 500 V N030	4411-0105	72982	801, 10 pF ±5%	
C18	Mica, 130 pF ±5% 500 V	4700-0439	14655	22A, 130 pF ±5%	
C19	Cer., 75 pF ±5% 500 V N030	4411-0753	72982	801, 75 pF ±5%	
C20 and					
C21	Trimmer, ceramic, 5.5-18 pF	4910-1201	72982	538-011, 5.5-18 pF	
C22	Cer., 27 pF ±5% 100 V N750	4417-2002	80131	CC62, 27 pF ±5%	
C23	330 pF ±5% 500 V	4404-1335	72982	0831082Z5D00331J	
C24	Cer., 2200 pF ±5% 500 V	4406-2225	72982	811, 2200 pF ±5%	5910-899-0668
C25	Cer., 150 pF ±5% 500 V	4404-1155	72982	831, 150 pF ±5%	5910-952-8403
C26	Tantalum, 3.3 uF ±20% 15 V	4450-4600	56289	150D335X0015A2	5910-837-9325
DIODES					
CR1 and					
CR2	MV2111	6084-1031	17680	MV2111	
CR3					
CR4	IN4151	6082-1001	24446	IN4151	
FILTERS					
LR1 and					
LR2	Bead	5000-1250	02114	56-590-65/4B	
INDUCTORS					
L1	Molded, 22 uH ±10%	4300-2600	99800	1537, 22 uH ±10%	5950-951-9266
L2 and					
L3	Molded, 3.9 uH ±10%	4300-1500	99800	1537-26, 3.9 uH ±10%	
L4	ASM (RD)	1169-2412	24655	1169-2412	
L5 and					
L6	Molded, 4.7 uH ±10%	4300-1600	99800	1538-28, 4.7 uH ±10%	
L7	Molded, 1.8 uH ±10%	4300-1100	99800	1537, 1.8 uH ±20%	
L8	Molded, 0.47 uH ±20%	4300-0400	99800	1537, 47 uH ±20%	5950-135-6007
L9	Molded, 1.8 uH ±10%	4300-1100	99800	1537, 1.8 uH ±20%	
L10	Molded, 0.47 uH ±20%	4300-0400	99800	1537, 0.47 uH ±20%	5950-135-6007
L11 and					
L12	Molded, 0.22 uH ±10%	4300-7551	72259	1025, 0.22 uH ±10%	
L13	Shielded, 470 uH ±10%	4300-6367	99800	3500, 470 uH ±10%	
L14	Shielded, 680 uH ±10%	4300-6386	99800	1537-742, 680 uH, ±10%	

ELECTRICAL PARTS LIST (cont)

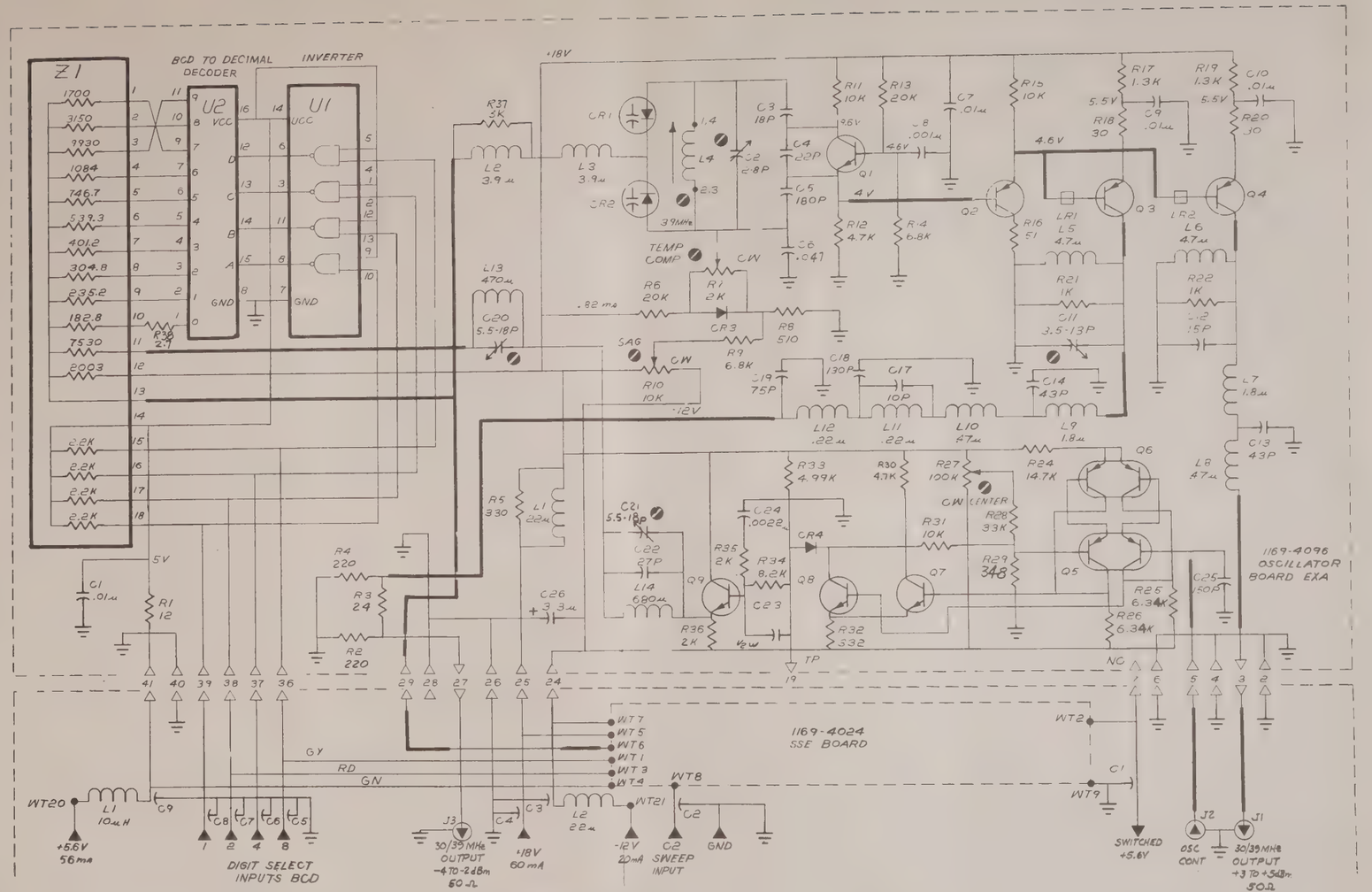
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
INTEGRATED CIRCUITS					
U1	Digital, Type SN74L00N	5431-8300	96214	SN74L00N	
U2	Digital, Type SN7445N	5431-8145	96214	SN7445N	
RESISTORS					
R1	Comp., 12 ohms, ±5% 1/4 W	6099-0125	01121	RC07GF-120J	5905-806-0633
R2	Comp., 220 ohms, ±5% 1/4 W	6099-1225	01121	RC07GF-221J	5905-683-2240
R3	Comp., 24 ohms, ±5% 1/4 W	6099-0245	01121	RC07GF-240J	
R4	Comp., 220 ohms, ±5% 1/4 W	6099-1225	01121	RC07GF-221J	5905-683-2240
R5	Comp., 330 ohms, ±5% 1/4 W	6099-1335	01121	RC07GF-331J	5905-686-3369
R6	Comp., 20 k ohms, ±5% 1/4 W	6099-3205	01121	RC07GF-203J	5905-686-3368
R7	Pot. wire wound, 2 k ohms, ±10%	6051-2209	07999	2600 PC, 2 k ohms, ±10%	
R8	Comp., 510 ohms, ±5% 1/4 W	6099-1515	01121	RC07GF511J	5905-801-8272
R9	Comp., 6.8 k ohms, ±5% 1/4 W	6099-2685	01121	RC07GF-682J	5905-686-9997
R10	Pot., wire wound, 10 k ohms, ±10%	6051-3109	02660	2600PC, 10 k ohms, ±10%	
R11	Comp., 10 k ohms, ±5% 1/4 W	6099-3105	01121	RC07GF-103J	5905-683-2238
R12	Comp., 4.7 k ohms, ±5% 1/4 W	6099-2475	01121	RC07GF-472J	5905-686-9992
R13	Comp., 20 k ohms, ±5% 1/4 W	6099-3205	01121	RC07GF-203J	5905-686-3368
R14	Comp., 6.8 k ohms, ±5% 1/4 W	6099-2685	01121	RC07GF-682J	5905-686-9997
R15	Comp., 10 k ohms, ±5% 1/4 W	6099-3105	01121	RC07GF-103J	5905-683-2238
R16	Comp., 51 ohms, ±5% 1/8 W	6098-0515	01121	RC05GF-510J	
R17	Comp., 1.3 k ohms, ±5% 1/4 W	6099-2135	01121	RC07GF-132J	5905-686-3119
R18	Comp., 30 ohms, ±5% 1/4 W	6099-0305	01121	RC07GF-300J	
R19	Comp., 1.3 k ohms, ±5% 1/4 W	6099-2135	01121	RC07GF-132J	5905-686-3119
R20	Comp., 30 ohms, ±5% 1/4 W	6099-0305	01121	RC07GF-300J	
R21 and					
R22	Comp., 1 k ohm, ±5% 1/4 W	6099-2105	01121	RC07GF-102J	5905-681-6422
R24	Film, 14.7 k ohms, ±10% 1/8 W	6250-2147	75042	CEA, 14.7 k ohms, ±1%	5905-702-1143
R25 and					
R26	Film, 6.34 k ohms, ±1% 1/8 W	6250-1634	75042	CEA, 6.34 k ohms, ±1%	
R27	Pot. cermet, 100 k ohms, ±10%	6049-0192	24655	6049-0192	
R28	Comp., 33 k ohms, ±5% 1/4 W	6099-3335	01121	RC07GF-333J	
R29	Film, 348 ohms, ±1% 1/8 W	6250-0348	01121	CEA, 348 ohms, ±1%	5905-571-1782
R30	Comp., 4.7 k ohms, ±5% 1/4 W	6099-2475	01121	RC07GF-472J	5905-686-9992
R31	Film, 10.0 k ohms, ±1% 1/8 W	6250-2100	01121	CEA, 10.0 k ohms, ±1%	5905-883-4847
R32	Film, 332 ohms, ±1% 1/8 W	6250-0332	01121	CEA, 332 ohms, ±1%	5905-681-8757
R33	Film, 4.99 k ohms, ±1% 1/8 W	6250-1499	01121	CEA, 4.99 k ohms, ±1%	
R34	Comp., 8.2 k ohms, ±5% 1/4 W	6099-2825	01121	RC07GF-822J	
R35	Comp., 2 k ohms, ±5% 1/4 W	6099-2205	01121	RC07GF-202J	5905-686-3370
R36	Comp., 2 k ohms, ±5% 1/2 W	6100-2205	01121	RC20GF202J	5905-190-8887
R37	Comp., 3.0 k ohms, ±5% 1/4 W	6099-2305	01121	RC07GF302J	5905-279-1751
R38	Comp., 2.7 ohms, ±5% 1/4 W	6099-9275	01121	RC07GF2R7J	
Z1	Resistive network, thin film	1169-0810	24655	1169-0810	
TRANSISTORS					
Q1	Type 2N3563	8210-1066	07263	2N3563	
Q2 thru					
Q4	Type 2N4258	8210-1136	07263		
Q5 and					
Q6	Type TD-400	8210-1169	56289	TD-400	
Q7 thru					
Q9	Type 2N3391	8210-1092	24454	2N3391A	
1169-2023 ENCLOSURE BASE					
CAPACITORS					
C1 thru					
C9	Feedthru, 1000 pF, +100-0% 500 V	4400-2200	01121	FA5C, 1000 pF, +100-0%	
CONNECTORS					
J1 thru					
J3	RF Insert	1165-6020	24655	1165-6020	
S01	Contact Strip Asm.	1165-1830	24655	1165-1830	
S02	Contact Strip Asm.	1165-1942	24655	1165-1942	
S03	Contact Strip Asm.	1165-1853	24655	1165-1853	
INDUCTORS					
L1	Molded, 10 uH ± 10%	4300-6500	99800	2150, 10 uH ± 10%	
L2	Molded, 22 uH ± 10%	4300-2600	99800	1537, 22 uH ± 10%	5950-951-9266





Etched-circuit diagram, Digit Oscillator board — EXA (P/N 1169-4096).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is not shown. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.



COMPONENTS USED:

RESISTORS: R1 THRU R22
R24 THRU R38
TRANSISTORS: Q1 THRU Q9
CAPACITORS: C1 THRU C14
C17 THRU C26
DIODES: CR1 THRU CR4
INTEGRATED CIRCUITS: U1, U2
TRANSFORMERS: L1 THRU L14
FERRITE BEADS: LR1, LR2

TRANSISTOR BASING DIAGRAM

Q5,Q6 Q1,Q2,Q3,Q4 Q7,Q8,Q9

Figure 6-10. 30-MHz digit oscillator — EXA (P/N 1169-4096).

ELECTRICAL PARTS LIST

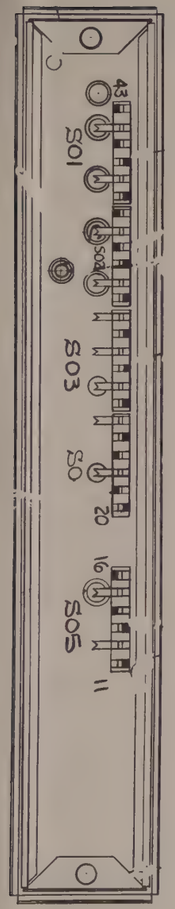
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4053 300 MHz DO SAMPLER BOARD (GL)					
CAPACITORS					
C1	Cer. Sq., 3.3 pF 0.1 pF 100 V NPO	4410-1200	72982	8101A100COG339	
C2	Cer. Disc, 1000 pF 5% 500 V	4405-2105	72982	0801082Z5D00102J	
C3	Cer. Disc, 1000 pF 5% 500 V	4405-2105	72982	0801082Z5D00102J	
C4	Cer. Disc, .01 uF 80/20% 100 V	4401-3100	72982	0805540Z5U00103Z	
C5	Cer. Mono., .0068 uF 10% 50 V S	4400-6356	72982	8121-M050-W5R-472K	
C6	Cer. Sq., 24 pF 5% 100 V NO30	4411-2006	72982	8121B101B1G0240J	
C7	Cer. Sq., .10 uF 80/20% 100 V	4403-4100	72982	8131M100651104Z	
C8	Cer. Disc, .01 uF 80/20% 100 V	4401-3100	72982	0805540Z5U00103Z	
C9	Cer. Disc, .01 uF 80/20% 100 V	4401-3100	72982	0805540Z5U00103Z	
C10	Cer. Mono., 1 uF 20% 50 V GP	4400-2070	72982	8131-M050-651-105M	
C11	Cer. Mono., 0.1 uF 20% 50 V GP	4400-2050	72982	8131-M050-651-104M	
C12	Cer. Sq., 10 pF 0.1 pF 100 V NPO	4410-1206	72982	8101A100COG100	
C13	Cer. Disc, .01 uF 80/20% 100 V	4401-3100	72982	0805540Z5U00103Z	
C14	Cer. Disc, .01 uF 80/20% 100 V	4401-3100	72982	0805540Z5U00103Z	
C15	Cer. Sq., 10 pF 0.1 pF 100 V NPO	4410-1206	72982	8101A100COG100	
C16	Cer. Sq., 150 pF 5% 100 V NO30	4400-6254	72982	8141A100B1G0151J	
C17	Cer. Sq., 150 pF 5% 100 V NO30	4400-6254	72982	8141A100B1G0151J	
C18	Cer. Sq., 150 pF 5% 100 V NO30	4400-6254	72982	8141A100B1G0151J	
C19	Cer. Disc, 1000 pF 5% 500 V	4405-2105	72982	0801082Z5D00102J	
C20	Cer. Disc, .01 uF 80/20% 100 V	4401-3100	72982	0805540Z5U00103Z	
C21	Cer. Disc, 1000 pF 5% 500 V	4405-2105	72982	0801082Z5D00102J	
C22	Cer. Disc, .01 uF 80/20% 100 V	4401-3100	72982	0805540Z5U00103Z	
C23	Cer. Disc, .01 uF 80/20% 100 V	4401-3100	72982	0805540Z5U00103Z	
C24	Cer. Disc, .01 uF 80/20% 100 V	4401-3100	72982	0805540Z5U00103Z	
C25	Cer. Sq., 24 pF 5% 100 V NO30	4411-2006	72982	8121B101B1G0240J	
C26	Cer. Sq., 68 pF 5% 100 V NO30	4411-2004	72982	8131A100B1G0680J	
C27	Cer. Disc, .01 uF 80/20% 100 V	4401-3100	72982	0805540Z5U00103Z	
C28	Cer. Trim, 7-25 pF PC N300	4910-2032	72982	538-006 B 7-25PF	
C29	Cer. Disc, .01 uF 80/20% 100 V	4401-3100	72982	0805540Z5U00103Z	
C30	Cer. Disc, .01 uF 80/20% 100 V	4401-3100	72982	0805540Z5U00103Z	
C31	Cer. Disc, .01 uF 80/20% 100 V	4401-3100	72982	0805540Z5U00103Z	
C32	Cer. Sq., 24 pF 5% 100 V NO30	4411-2006	72982	8121B101B1G0240J	
C33	Cer. Mono., 2.2 uF 20% 50 V GP	4400-2080	72982	8141-M050-651-225M	
C34	Cer. SQ., 3.3 pF 0.1 pF 100 V NPO	4410-1200	72982	8101A100COG339	
C36	Cer. Sq., 5.1 pF 5% 100 V NPO	4410-1201	72982	8101A100COG519J	
C37	Cer. Disc, .01 uF 80/20% 100 V	4401-3100	72982	0805540Z5U00103Z	
C38	Cer. Sq., 120 pF 5% 100 V NPO	4410-1235	72982	8131A100COG121J	
DIODES					
CR1	Type MSQ1005-20-4	6082-1023	13327	MSQ-1005-20-4	
CR2	Type MSQ1005-20-4	6082-1023	13327	MSQ-1005-20-4	
CR3	Type MSQ1005-20-4	6082-1023	13327	MSQ-1005-20-4	
CR4	Type MSQ1005-20-4	6082-1023	13327	MSQ-1005-20-4	
CR5	Step Recov	6084-1027	17540	M0271C	
CR6	Type 1N4151	6082-1001	14433	1N3604	
CR7	Type 1N4151	6082-1001	14433	1N3604	
CR8	Type 1N4151	6082-1001	14433	1N3604	
CR9	Type 1N4151	6082-1001	14433	1N3604	
CR11	Zener Type 1N752A 5.6 V 5%	6083-1004	14433	IN752A	
INDUCTORS					
L1	R-F Coil, Adjust.	1169-2250	24655	1169-2250	
L2	Choke Molded, 3.9 uH 10%	4300-7526	72259	DD-3.9	
L3	Choke Molded, 12 uH 10%	4300-7525	72259	DD-12	
L4	Choke Molded, 12 uH 10%	4300-7525	72259	DD-12	
L5	Choke Molded, 0.15 uH 10%	4300-0101	24655	4300-0101	
L6	Choke Molded, 0.1 uH 10%	4300-7555	72259	DD-0.10	
L7	Ferrite Bead	5000-1250	02114	56-590-65/4B	
L8	Coil, 10 uH	4300-2275	24655	4300-2275	
L9	Choke Molded, 12 uH 10%	4300-7525	72259	DD-12	

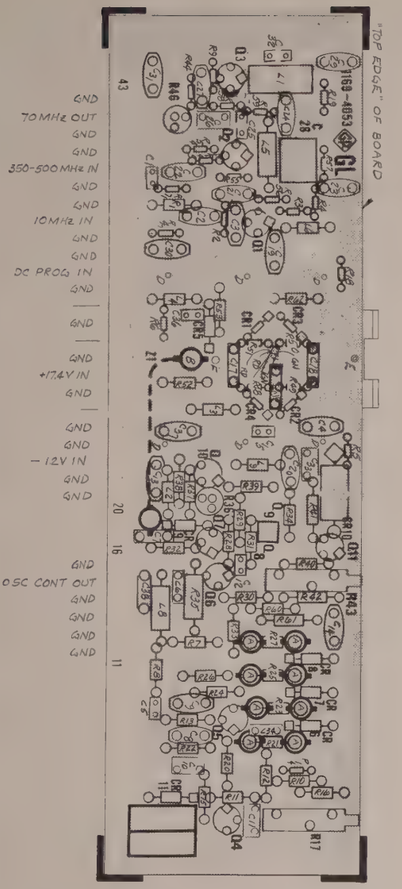
ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
RESISTORS					
R1	Comp, 30 ohm, 5% 1/4 W	6099-0305	81349	RCR07G300J	
R2	Comp, 750 ohm, 5% 1/8 W	6098-1755	81349	RCR05G821J	
R3	Comp, 8.2 k, 5% 1/8 W	6098-2825	81349	RCR05G822J	
R4	Comp, 8.2 k, 5% 1/8 W	6098-2825	81349	RCR05G822J	
R5	Comp, 10 ohm, 5% 1/8 W	6098-0105	81349	RCR05G100J	
R6	Comp, 10 ohm, 5% 1/8 W	6098-0105	81349	RCR05G100J	
R7	Comp, 470 ohm, 5% 1/4 W	6099-1475	81349	RCR07G471J	
R8	Comp, 150 ohm, 5% 1/4 W	6099-1155	81349	RCR07G151J	
R9	Comp, 1.2 k, 5% 1/8 W	6098-2125	81349	RCR05G122J	
R10	Comp, 1.2 k, 5% 1/4 W	6099-2125	81349	RCR07G122J	
R11	Film, 2.21 k, 1% 1/8 W	6250-1221	81349	RN55D2211F	
R12	Film, 2.74 k, 1% 1/8 W	6250-1274	81349	RN55D2741F	
R13	Film, 2k, 1% 1/8 W	6250-1200	81349	RN55D2001F	
R14	Comp, 10 ohm, 5% 1/8 W	6098-0105	81349	RCR05G100J	
R15	Comp, 1.0 k, 5% 1/4 W	6099-2105	81349	RCR07G102J	
R16	Film, 2 k, 1% 1/8 W	6250-1200	81349	RN55D2001F	
R17	Pot. W.W. Trm, 2 k ohm, 10%	6051-2209	80294	3005P-1-202	
R18	Comp, 10 ohm, 5% 1/8 W	6098-0105	81349	RCR05G100J	
R19	Comp, 10 ohm, 5% 1/8 W	6098-0105	81349	RCR05G100J	
R20	Comp, 820 ohm, 5% 1/4 W	6099-1825	81349	RCR07G821J	
R21	Film, 750 ohm, 1% 1/8 W	6250-0750	81349	RN55D7500F	
R22	Comp, 560 ohm, 5% 1/4 W	6099-1565	81349	RCR07G561J	
R23	Film, 6.81 k, 1% 1/8 W	6250-1681	81349	RN55D6811F	
R24	Film, 301 ohm, 1% 1/8 W	6250-0301	81349	RN55D3010F	
R25	Film, 1.82 k, 1% 1/8 W	6250-1182	81349	RN55D1821F	
R26	Film, 100 ohm, 1% 1/8 W	6250-0100	81349	RN55D1000F	
R27	Film, 1.47 k, 1% 1/8 W	6250-1147	81349	RN55D1471F	
R28	Comp, 10 ohm, 5% 1/4 W	6099-0105	81349	RCR07G100J	
R29	Comp, 3.3 k, 5% 1/4 W	6099-2335	81349	RCR07G332J	
R30	Film, 2 k, 1% 1/8 W	6250-1200	81349	RN55D2001F	
R31	Comp, 220 ohm, 5% 1/4 W	6099-1225	81349	RCR07G221J	
R32	Comp, 4.7 k, 5% 1/4 W	6099-2475	81349	RCR07G472J	
R33	Comp, 4.7 k, 5% 1/4 W	6099-2475	81349	RCR07G472J	
R34	Comp, 18 k, 5% 1/4 W	6099-3185	81349	RCR07G183J	
R35	Comp, 2.0 k ohm, 5% 1/2 W D	6100-2205	81349	RCR20G202J	
R36	Cerm. Trm, 20 k ohm, 20% 1 T	6049-0110	80294	3329H-1-203	
R37	Comp, 1.3 m ohm, 5% 1/4 W D	6099-5135	81349	RCR07G135J	
R38	Comp, 24 k ohm, 5% 1/4 W D	6099-3245	81349	RCR07G243J	
R39	Comp, 1.3 m ohm, 5% 1/4 W D	6099-5135	81349	RCR07G135J	
R40	Comp, 510 ohm, 5% 1/4 W D	6099-1515	81349	RCR07G511J	
R41	Film, 2.55 k, 1% 1/8 W	6250-1255	81349	RN55D2551F	
R42	Film, 3.16 k, 1% 1/8 W	6250-1316	81349	RN55D3161F	
R43	W.W. Trm, 5 k ohm, 10% 20 T	6051-2509	80294	3005P-1-502	
R44	Comp, 22 ohm, 5% 1/8 W	6098-0225	81349	RCR05G220J	
R45	Comp, 18 ohm, 5% 1/8 W	6098-0185	81349	RCR05G180J	
R46	Cerm. Trm, 100 ohm, 20% 1 T	6049-0103	80294	3329H-1-101	
R47	Comp, 100 ohm, 5% 1/8 W	6098-1105	81349	RCR05G101J	
R48	Comp, 100 ohm, 5% 1/8 W	6098-1105	81349	RCR05G101J	
R49	Comp, 100 ohm, 5% 1/8 W	6098-1105	81349	RCR05G101J	
R50	Comp, 100 ohm, 5% 1/8 W	6098-1105	81349	RCR05G101J	
R51	Comp, 100 ohm, 5% 1/8 W	6098-1105	81349	RCR05G101J	

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
RESISTORS (cont)					
R52	Comp, 300 ohm, 5% 1/4 W D	6099-1305	81349	RCR07G301J	
R53	Comp, 150 ohm, 5% 1/4 W	6099-1155	81349	RCR07G151J	
R54	Comp, 5.6 k, 5% 1/8 W	6098-2565	81349	RCR05G562J	
R55	Comp, 8.2 k, 5% 1/8 W	6098-2825	81349	RCR05G822J	
R56	Comp, 8.2 k, 5% 1/8 W	6098-2825	81349	RCR05G822J	
R57	Comp, 10 ohm, 5% 1/8 W	6098-0105	81349	RCR05G100J	
R58	Comp, 8.2 k, 5% 1/8 W	6098-2825	81349	RCR05G822J	
R59	Comp, 8.2 k, 5% 1/8 W	6098-2825	81349	RCR05G822J	
R60	Comp, 220 ohm, 5% 1/4 W	6099-1225	81349	RCR07G221J	
R61	Film, 20.5 k, 1% 1/8 W	6250-2205	81349	RN55D2052F	
R62	Comp, 51 ohm, 5% 1/4 W D	6099-0515	81349	RCR07G510J	
R71	Comp, 75 ohm, 5% 1/8 W D	6098-0755	81349	RCR05G750J	
TRANSISTOR					
Q1	Type 2N5179	8210-1195	04713	2N5179	
Q2	Type 2N5179	8210-1195	04713	2N5179	
Q3	Type 2N5179	8210-1195	04713	2N5179	
Q4	Type 2N3903	8210-1132	04713	2N3903	
Q5	Type 2N3903	8210-1132	04713	2N3903	
Q6	Type 2N3903	8210-1132	04713	2N3903	
Q7	Type 2N3903	8210-1132	04713	2N3903	
Q8	Special	1165-2990	24655	1165-2990	
Q9	Special	1165-2990	26555	1165-2990	
Q10	Type 2N5249	8210-1077	03508	2N5249	
Q11	Type 2N3903	8210-1132	04713	2N3903	
TRANSFORMERS					
T1	Pulse	1165-2240	24655	1165-2240	
1169-2012 ENCLOSURE BASE (GX)					
CAPACITORS					
GX-C1 and CX-C2	Cer., 1000 pF + 100-0% 500 V	4400-2200	01121	F45C, 1000 pF +100-0%	
GX-C3	Cer., Trim, 2-8 pF NPO	4910-2042	72982	538-00M 2-8 pF	
CONNECTORS					
GX-J2 thru GX-J4 and GX-J6 and GX-J7	RF Insert	1165-6020	24655	1165-6020	
S01	Contact strip asm.	1165-1820	24655	1165-1820	
S02	Contact strip asm.	1165-1820	24655	1165-1820	
S03	Contact strip asm.	1165-1830	24655	1165-1830	
S04	Contact strip asm.	1165-1821	24655	1165-1821	
S05	Contact strip asm.	1165-1820	24655	1165-1820	
INDUCTOR					
GX-L1	Choke, Molded, 1.0 uH, 10%	4300-0700	99800	1537-12	





NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is not shown. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

Etched-circuit diagram; sampler circuit board – GL (P/N 1169-4053).

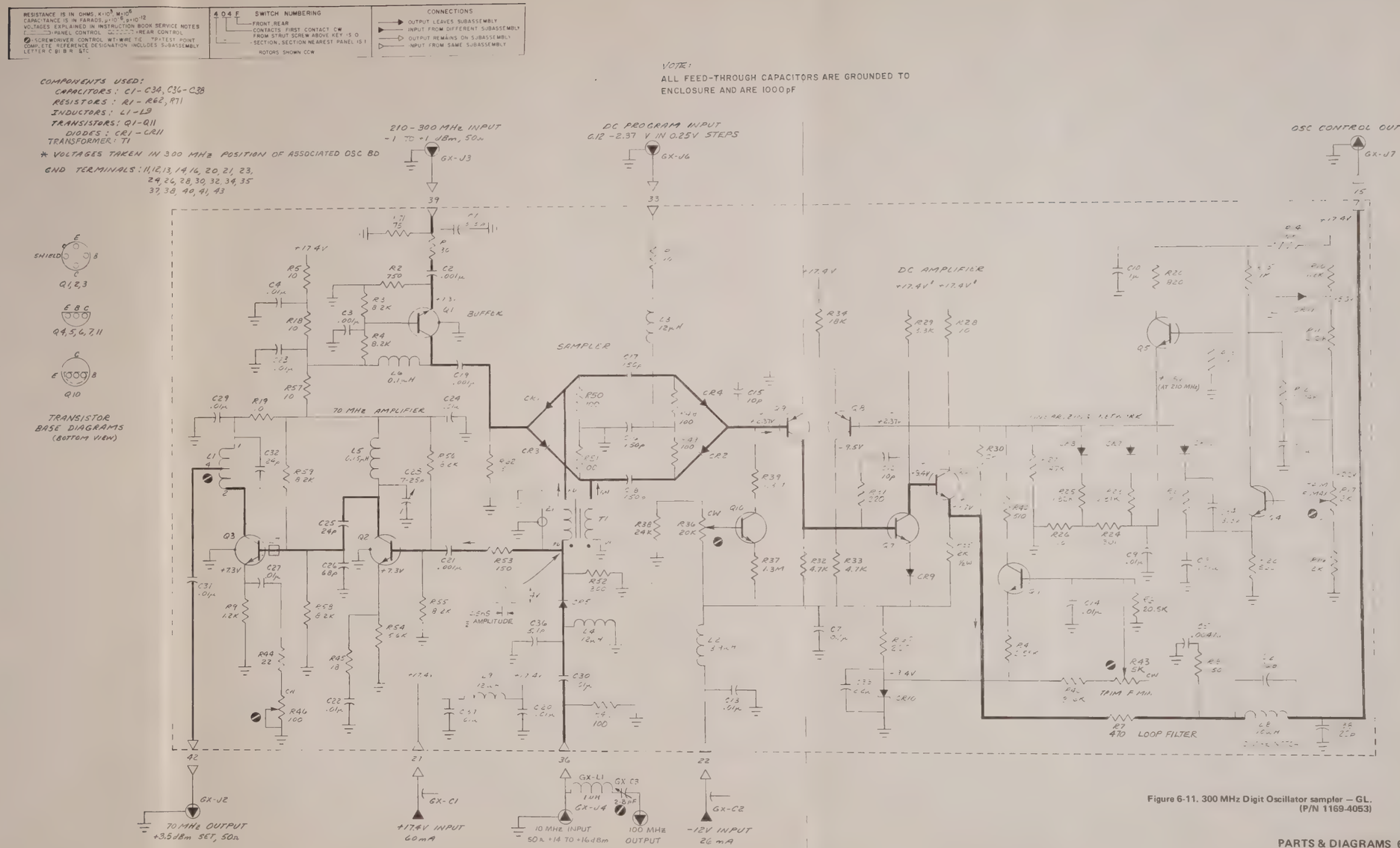


Figure 6-11. 300 MHz Digit Oscillator sampler – GL. (P/N 1169-4053)

ELECTRICAL PARTS LIST

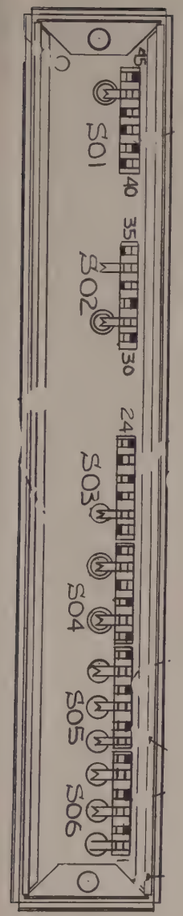
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
	OSCILLATOR CIRCUIT ASM				
	CAPACITORS				
C1	Cer. Sq., 6.8 pF 5% 100 V NO30	4411-2014	72982	8101A100B1G689J	
C2	Cer. Tub., 7.5 pF 5% 500 V	4400-0900	95121	QC 7.5 pF 5% 500 V	
C3	Cer. Sq., 13 pF 5% 100 V NO30	4411-2020	72982	8111A100B1G130J	
C4	Cer. Tub., 2.4 pF 5% 500 V	4400-0250	95121	QC 2.4 pF 5% 500 V	
C5	Cer. Sq., 10 pF 5% 100 V NO30	4411-2018	72982	8111A100B1G100J	
C6	Cer., .1 Sq. 330 pF 10% 100 V	4400-6441	72982	8111 A200-X5R0331K	
C7	Cer., .1 Sq. 330 pF 10% 100 V	4400-6441	72982	8111 A200-X5R0331K	
C8	Cer. Trim, 4.5-20 pF PC U	4910-2070	52763	7S-TRIKO. 02 4.5/20	
C9	Cer. Sq., 9.1 pF 5% 100 V NO30	4411-2017	72982	8101A100B1G919J	
C10	Cer. Sq., 2.7 pF & -2.5 pF 100 V	4417-2003	72982	8101A100B1G300J	
C11	Cer., .1 Sq. 330 pF 10% 100 V	4400-6441	72982	8111 A200-X5R0331K	
C12	Cer., .2 Sq. 1000 pF 5% 100 V S	4400-2139	72982	8121A100Y5F102J	
C13	Cer., .2 Sq. 1000 pF 5% 100 V S	4400-2139	72982	8121A100Y5F102J	
C14	Cer., .2 Sq. 1000 pF 5% 100 V S	4400-2139	72982	8121A100Y5F102J	
C15	Cer., .1 Sq. 330 pF 10% 100 V	4400-6441	72982	8111 A200-X5R0331K	
C16	Cer., .1 Sq. 3300 pF 10% 100 V	4400-6441	72982	8111 A200-X5R0331K	
C17	Cer., .1 Sq. 330 pF 10% 100 V	4400-6441	72982	8111 A200-X5R0331K	
C18	Cer., .1 Sq. 330 pF 10% 100 V	4400-6441	72982	8111 A200-X5R0331K	
C19	Tant., 1.5 uF 20% 20 V	4450-4400	56289	150D155X0020A2	
C20	Cer., .1 Sq. 330 pF 10% 100 V	4400-6441	72982	8111 A200-X5R0331K	
C21	Cer., .1 Sq. 330 pF 10% 100 V	4400-6441	72982	8111 A200-X5R0331K	
C22	Cer., .1 Sq. 330 pF 10% 100 V	4400-6441	72982	8111 A200-X5R0331K	
C23	Cer., .1 Sq. 330 pF 10% 100 V	4400-6441	72982	8111 A200-X5R0331K	
C24	Cer., .1 Sq. 330 pF 10% 100 V	4400-6441	72982	8111 A200-X5R0331K	
C25	Tant., 4.7 uF 20% 10 V	4450-4700	56289	150D475X0010A2	
C26	Tant., 4.7 uF 20% 10 V	4450-4700	56289	150D475X0010A2	
C27	Varcp., BA141 PIV30	6084-1028	14433	BA141	
C28	Varcp., BA141 PIV30	6084-1028	14433	BA141	
C29	Varcp., BA141 PIV30	6084-1028	14433	BA141	
C30	Varcp., BA141 PIV30	6084-1028	14433	BA141	
C31	Cer., .1 Sq. 330 pF 10% 100 V	4400-6441	72982	8111 A200-X5R0331K	
	DIODES				
VR3	Zener 1N825 6.2 V 5%	6083-1060	03877	IN825	
	INDUCTORS				
L1	R-F Coil, 18 uH	1169-8046	24655	1169-8046	
L2	R-F Coil, 28 uH	1169-8045	24655	1169-8045	
L3	Choke Molded, 1.5 uH 10%	4300-1000	99800	1537-16	
L4	R-F Coil, tapped	1169-8050	24655	1169-8050	
L5	Choke Molded, 0.15 uH 10%	4300-7553	72259	DD-0.15	
L7	Choke Molded, 0.15 uH 10%	4300-7553	72259	DD-0.15	
L8	Choke Molded, 0.15 uH 10%	4300-7553	72259	DD-0.15	
	INTEGRATED CIRCUITS				
U1	Type AM3705 CD	5434-0113	12040	AM3705CD	
U2	Type AM3705 CD	5434-0113	12040	AM3705CD	
	RESISTORS				
R1	Comp., 150 ohm 5% 1/4 W	6099-1155	81349	RCR07G151J	
R2	Comp., 36 ohm, 5% 1/4 W D	6099-0365	81349	RCR07G360J	
R3	Comp., 150 ohm, 5% 1/4 W	6099-1155	81349	RCR07G151J	
R4	Cerm. Trm., 100 ohm, 10% 1 T	6049-0292	80294	3329W-10-101	
R5	Comp., 56 ohm, 5% 1/4 W	6099-0565	81349	RCR07G560J	
R6	Comp., 10 ohm, 5% 1/8 W	6098-0105	81349	RCR05G100J	
R7	Comp., 10 ohm, 5% 1/8 W	6098-0105	81349	RCR05G100J	
R8	Comp., 560 ohm, 5% 1/4 W	6099-1565	81349	RCR07G561J	

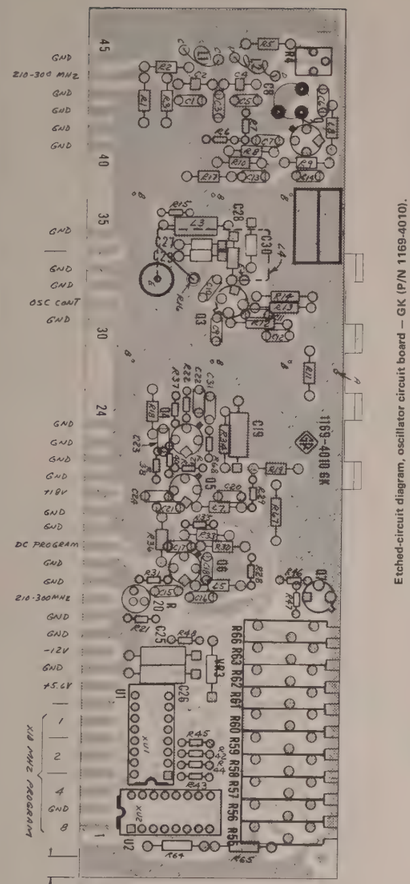
ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
	RESISTORS (cont)				
R9	Comp., 5.1 k ohm, 5% 1/4 W D	6099-2515	81349	RCR07G512J	
R10	Comp., 5.1 k ohm, 5% 1/4 W D	6099-2515	81349	RCR07G512J	
R11	Comp., 10 ohm, 5% 1/4 W	6099-0105	81349	RCR07G100J	
R12	Film, 2.1 k, 1% 1/8 W	6250-1210	81349	RN55D2101F	
R13	Film, 3.48 k, 1% 1/8 W	6250-1348	81349	RN55D3481F	
R14	Film, 7.5 k, 1% 1/8 W	6250-1750	81349	RN55D7501F	
R15	Comp., 47 ohm, 5% 1/8 W	6098-0475	81349	RCR05G470J	
R16	Comp., 18 ohm, 5% 1/4 W	6099-0185	81349	RCR07G180J	
R17	Comp., 30 ohm, 5% 1/5 W D	6099-0305	81349	RCR07G300J	
R18	Comp., 47 ohm, 5% 1/4 W	6099-0475	81349	RCR07G470J	
R19	Comp., 22 ohm, 5% 1/4 W	6099-0225	81349	RCR07G220J	
R20	Pot. Cerm. Trm., 50 ohm, 20% 1 T	6049-0102	80294	3329H-1-500	
R21	Comp., 100 ohm, 5% 1/8 W	6098-1105	81349	RCR05G101J	
R22	Comp., 47 ohm, 5% 1/8 W	6098-0475	81349	RCR05G470J	
R27	Comp., 6.8 k, 5% 1/8 W	6098-2685	81349	RCR05G682J	
R28	Comp., 22 ohm, 5% 1/8 W	6098-0225	81349	RCR05G220J	
R29	Comp., 22 ohm, 5% 1/8 W	6098-0225	81349	RCR05G220J	
R30	Comp., 560 ohm, 5% 1/4 W	6099-1565	81349	RCR07G561J	
R31	Comp., 5.1 k ohm, 5% 1/8 W D	6098-2515	81349	RCR05G512J	
R33	Comp., 150 ohm, 5% 1/4 W	6099-1155	81349	RCR07G151J	
R34	Comp., 10 ohm, 5% 1/4 W	6099-0105	81349	RCR07G100J	
R35	Comp., 5.1 k ohm, 5% 1/8 W D	6098-2515	81349	RCR05G512J	
R36	Comp., 47 ohm, 5% 1/4 W	6099-0475	81349	RCR07G470J	
R37	Comp., 200 ohm, 5% 1/8 W D	6098-1205	81349	RCR05G201J	
R38	Comp., 2.7 k, 5% 1/8 W	6098-2275	81349	RCR05G272J	
R40	Comp., 6.8 k, 5% 1/8 W	6098-2685	81349	RCR05G682J	
R42	Comp., 5.1 k ohm, 5% 1/8 W D	6098-2515	81349	RCR05G512J	
R43	Comp., 5.1 k ohm, 5% 1/8 W D	6098-2515	81349	RCR05G512J	
R44	Comp., 5.1 k ohm, 5% 1/8 W D	6098-2515	81349	RCR05G512J	
R45	Comp., 5.1 k ohm, 5% 1/8 W D	6098-2515	81349	RCR05G512J	
R46	Comp., 10 k, 5% 1/8 W	6098-3105	81349	RCR05G103J	
R47	Comp., 10 k, 5% 1/8 W	6098-3105	81349	RCR05G103J	
R48	Comp., 5.1 k ohm, 5% 1/8 W D	6098-2515	81349	RCR05G512J	
R55	Pot. W.W. Trm., 200 ohm, 10% 20 T	6051-1209	80294	3005P-1-201	
R56	Pot. W.W. Trm., 200 ohm, 10% 20 T	6051-1209	80294	3005P-1-201	
R57	Pot. W.W. Trm., 200 ohm, 10% 20 T	6051-1209	80294	3005P-1-201	
R58	Pot. W.W. Trm., 200 ohm, 10% 20 T	6051-1209	80294	3005P-1-201	
R59	Pot. W.W. Trm., 200 ohm, 10% 20 T	6051-1209	80294	3005P-1-201	
R60	Pot. W.W. Trm., 200 ohm, 10% 20 T	6051-1209	80294	3005P-1-201	
R61	Pot. W.W. Trm., 200 ohm, 10% 20 T	6051-1209	80294	3005P-1-201	
R62	Pot. W.W. Trm., 200 ohm, 10% 20 T	6051-1209	80294	3005P-1-201	
R63	Pot. W.W. Trm., 200 ohm, 10% 20 T	6051-1209	80294	3005P-1-201	
R64	Film, 100 ohm, 1% 1/8 W	6250-0100	81349	RN55D1000F	
R65	Film, 2.61 k, 1% 1/8 W	6250-1261	81349	RN55D2611F	
R66	Pot. W.W. Trm., 1 k ohm, 10% 20 T	6051-2109	80294	3005P-1-102	
R67	Film, 1.27 k, 1% 1/8 W	6250-1127	81349	RN55D1271F	
R68	Comp., 100 ohm, 5% 1/8 W	6098-1105	81349	RCR05G101J	
	TRANSISTORS				
Q2	Type 2N5179	8210-1195	04713	2N5179	
Q3	Type 2N3933	8210-1122	34156	2N3933	
Q4	Type 2N5179	8210-1195	04713	2N5179	
Q5	Type 2N5179	8210-1195	04713	2N5179	
Q6	Type A485	8210-1194	73445	A485	
Q7	Type 2N2369	8210-1052	07263	2N2369	

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
	1169-2042 ENCLOSURE BASE (GY)				
	CAPACITORS				
GY-C1 thru GY-C7	Cer., 1000 pF +100-0% 500 V	4400-2200	01121	F45C, 1000 pF +100-0%	
	CONNECTORS				
GY-J1 thru GY-J4	RF Insert	1165-6020	24655	1165-6020	
S01	Contact strip asm.	1165-1812	24655	1165-1812	
S02	Contact strip asm.	1165-1820	24655	1165-1820	
S03	Contact strip asm.	1165-1811	24655	1165-1811	
S04	Contact strip asm.	1165-1820	24655	1165-1820	
S05 and S06	Contact strip asm.	1165-1831	24655	1165-1831	





Etched-circuit diagram, oscillator circuit board – GK (P/N 1169-4010).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is not shown. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

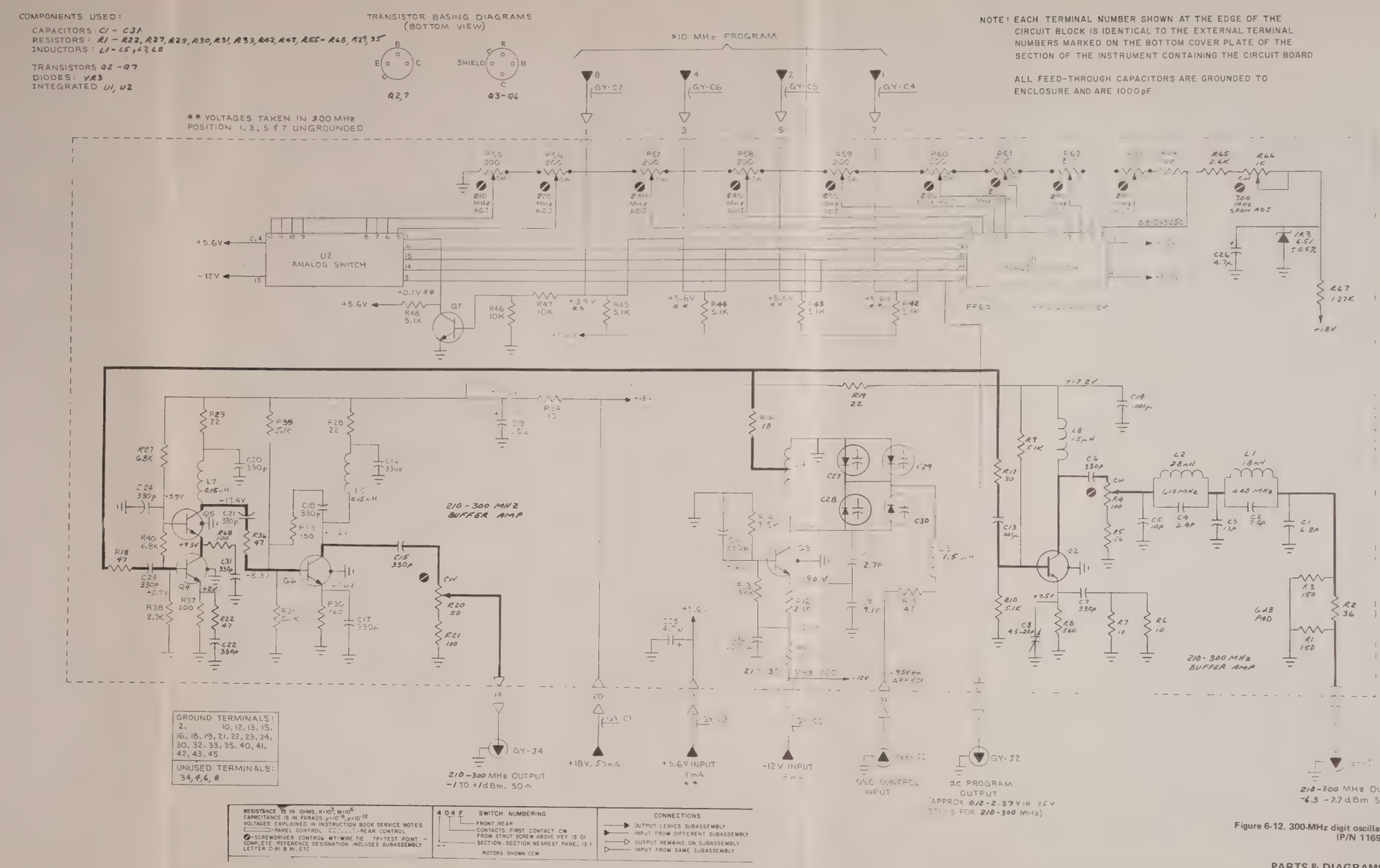
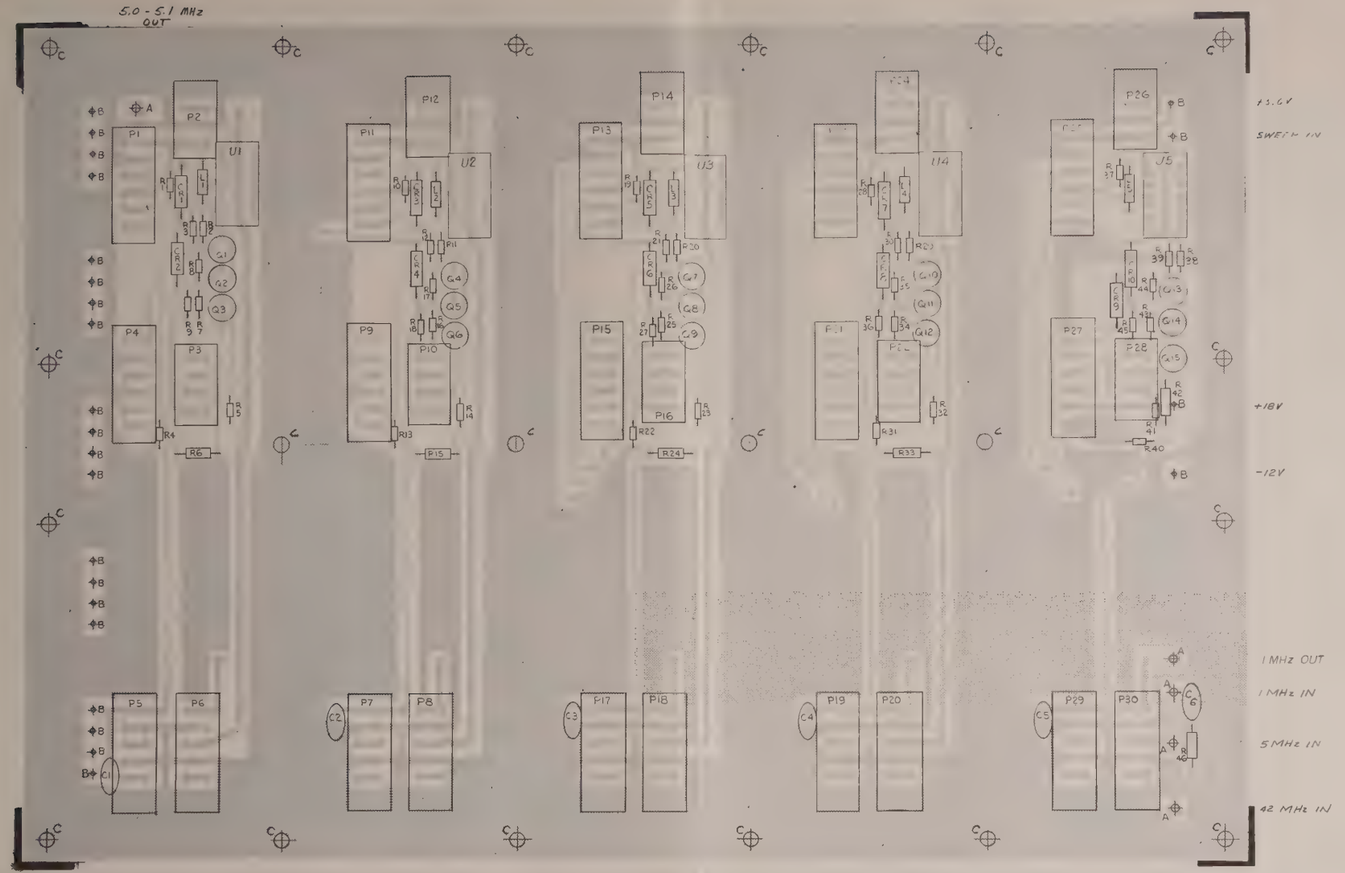

COMPONENTS USED:
CAPACITORS: C1 – C31.
RESISTORS: R1 – R22, R27, R28, R30, R31, R33, R42, R47, R55 – R68, R29, 35
INDUCTORS: L1 – L5, L7, L8
TRANSISTORS Q2 – Q7
DIODES: VR3
INTEGRATED U1, U2
TRANSISTOR BASING DIAGRAMS (BOTTOM VIEW)
Q2,7
Q3-Q6
NOTE: EACH TERMINAL NUMBER SHOWN AT THE EDGE OF THE CIRCUIT BLOCK IS IDENTICAL TO THE EXTERNAL TERMINAL NUMBERS MARKED ON THE BOTTOM COVER PLATE OF THE SECTION OF THE INSTRUMENT CONTAINING THE CIRCUIT BOARD
ALL FEED-THROUGH CAPACITORS ARE GROUNDED TO ENCLOSURE AND ARE 1000 pF
** VOLTAGES TAKEN IN 300 MHz POSITION 1, 3, 5 & 7 UNGROUNDED
×10 MHz PROGRAM
GY-C7
GY-C6
GY-C5
GY-C4
U2 ANALOG SWITCH
+5.6V
-12V
+0.1V **
Q7
210 MHz ADJ
220 MHz ADJ
240 MHz ADJ
260 MHz ADJ
300 MHz SPAN ADJ
FEED
+18V
210-300 MHz BUFFER AMP
+17.8V
+7.5V
GAB PAD
GROUND TERMINALS: 2, 10, 12, 13, 15, 16, 18, 19, 21, 22, 23, 24, 30, 32, 33, 35, 40, 41, 42, 43, 45
UNUSED TERMINALS: 34, 4, 6, 8
GY-J4
210-300 MHz OUTPUT -1 TO +1 dBm, 50Ω
+18V, 50 mA
+5.6V INPUT 7 mA **
-12V INPUT 5 mA
OSC CONTROL INPUT
GY-J2
DC PROGRAM OUTPUT APPROX 0.12-2.37 V IN .25 V STEPS FOR 210-300 MHz
210-300 MHz OUTPUT -6.3 -7.7 dBm 50Ω
RESISTANCE IS IN OHMS, K=10³, M=10⁶
CAPACITANCE IS IN FARADS, p=10⁻⁶, p=10⁻¹²
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
=PANEL CONTROL, =REAR CONTROL
=SCREWDRIVER CONTROL, WT=WIRE TIE, TP=TEST POINT, COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER C-R1 B R1, ETC
4 0 4 F SWITCH NUMBERING
FRONT, REAR
CONTACTS, FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY 15 01
SECTION, SECTION NEAREST PANEL, IS 1
ROTORS SHOWN CCW
CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY

Figure 6-12. 300-MHz digit oscillator GK (P/N 1169-4010)



Etched-circuit diagram, Motherboard — H (P/N 1169-4090).

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4090 MOTHER BOARD					
CAPACITORS					
C1 thru C5	Cer., 1000 pF ±10%	4405-2108	72982	801, 1000 pF ±10%	5910-914-0087
C6	Cer., 180 pF ±5% 500 V	4404-1185	72982	831, 180 pF ±5%	5910-952-8403
CONNECTORS					
P1	PC, 6 Pos, Dr.	4230-6221	00032	#4-583486-5	
P2	PC, 4 Pos, Dr.	4230-6222	00032	#4-583486-5	
P3	JC, 4 Pos, Dr.	4230-6222	00032	#4-583486-7	
P4 thru P9		4230-6221		#4-583486-5	
P10	PC, 4 Pos, Dr.	4230-6222	00032	#4-583486-5	
P11	PC, 6 Pos, Dr.	4230-6221	00032	#4-583486-5	
P12	PC, 4 Pos, Dr.	4230-6222	00032	#4-583486-5	
P13	PC, 6 Pos, Dr.	4230-6221	00032	#4-583486-5	
P14	PC, 4 Pos, Dr.	4230-6222	00032	#4-583486-5	
P15	PC, 6 Pos, Dr.	4230-6221	00032	#4-583486-5	
P16	PC, 4 Pos, Dr.	4230-6222	00032	#4-583486-5	
P17 thru P21	PC, 6 Pos, Dr.	4230-6221	00032	#4-583486-5	
P22	PC, 4 Pos, Dr.	4230-6222	00032	#4-583486-5	
P23	PC, 6 Pos, Dr.	4230-6221	00032	#4-583486-5	
P24	PC, 4 Pos, Dr.	4230-6222	00032	#4-583486-5	
P25	PC, 6 Pos, Dr.	4230-6221	00032	#4-583486-5	
P26	PC, 4 Pos, Dr.	4230-6222	00032	#4-583486-5	
P27	PC, 6 Pos, Dr.	4230-6221	00032	#4-583486-5	
P28	PC, 4 Pos, Dr.	4230-6222	00032	#4-583486-5	
P29 and P30	PC, 6 Pos, Dr.	4230-6221	00032	#4-583486-5	
DIODES					
CR1 thru CR10	Type BA136A	6082-1035	25088	BA136A	
INTEGRATED CIRCUITS					
U1 thru U5	Digital, Type SN74L00N	5431-8300	96214	SN74L00N	
INDUCTORS					
L1 thru L5	Molded, 220 uH ±10%	4300-7556	99800	1025-14, 220 uH ±10%	
RESISTORS					
R1 and R2	Comp., 3.3 kilohms, ±5% 1/8 W	6098-2335	01121	BB, 3.3 kilohms, ±5%	5905-681-9969
R3	Comp., 2 kilohms, ±5% 1/8 W	6098-2205	01121	BB, 2 kilohms, ±5%	5905-686-3370
R4	Comp., 56 kilohms, ±5% 1/8 W	6098-3565	01121	BB, 56 kilohms, ±5%	5905-800-0179
R5	Comp., 5.6 kilohms, ±5% 1/8 W	6098-2565	01121	BB, 5.6 kilohms, ±5%	5905-681-0195
R6	Comp., 680 ohms, ±5% 1/4 W	6099-1685	01121	RCR07G-681J	
R7	Comp., 2.2 kilohms, ±5% 1/8 W	6098-2225	01121	BB, 2.2 kilohms, ±5%	

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
RESISTORS (cont)					
R8	Comp., 27 kilohms, ±5% 1/8 W	6098-3275	01121	BB, 27 kilohms, ±5%	
R9	Comp., 56 kilohms, ±5% 1/8 W	6098-3565	01121	BB, 56 kilohms, ±5%	5905-800-0179
R10 and					
R11	Comp., 3.3 kilohms, ±5% 1/8 W	6098-2335	01121	BB, 3.3 kilohms, ±5%	5905-681-9969
R12	Comp., 2 kilohms, ±5% 1/8 W	6098-2205	01121	BB, 2 kilohms, ±5%	5905-686-3370
R13	Comp., 56 kilohms, ±5% 1/8 W	6098-3565	01121	BB, 56 kilohms, ±5%	5905-800-0179
R14	Comp., 5.6 kilohms, ±5% 1/8 W	6098-2565	01121	BB, 5.6 kilohms, ±5%	5905-691-0195
R15	Comp., 680 ohms, ±5% 1/4 W	6099-1685	01121	RCR07G-681J	
R16	Comp., 2.2 kilohms, ±5% 1/8 W	6098-2225	01121	BB, 2.2 kilohms, ±5%	
R17	Comp., 27 kilohms, ±5% 1/8 W	6098-3275	01121	BB, 27 kilohms, ±5%	
R18	Comp., 56 kilohms, ±5% 1/8 W	6098-3565	01121	BB, 56 kilohms, ±5%	5905-800-0179
R19 and					
R20	Comp., 3.3 kilohms, ±5% 1/8 W	6098-2335	01121	BB, 3.3 kilohms, ±5%	5905-681-9969
R21	Comp., 2 kilohms, ±5% 1/8 W	6098-2205	01121	BB, 2 kilohms, ±5%	5905-686-3370
R22	Comp., 56 kilohms, ±5% 1/8 W	6098-3565	01121	BB, 56 kilohms, ±5%	5905-800-0179
R23	Comp., 5.6 kilohms, ±5% 1/8 W	6098-2565	01121	BB, 5.6 kilohms, ±5%	5905-691-0195
R24	Comp., 680 ohms, ±5% 1/4 W	6099-1685	01121	RCR07G-681J	
R25	Comp., 2.2 kilohms, ±5% 1/8 W	6098-2225	01121	BB, 2.2 kilohms, ±5%	
R26	Comp., 27 kilohms, ±5% 1/8 W	6098-3275	01121	BB, 27 kilohms, ±5%	
R27	Comp., 56 kilohms, ±5% 1/8 W	6098-3565	01121	BB, 56 kilohms, ±5%	5905-800-0179
R28 and					
R29	Comp., 3.3 kilohms, ±5% 1/8 W	6098-2335	01121	BB, 3.3 kilohms, ±5%	5905-681-9969
R30	Comp., 2 kilohms, ±5% 1/8 W	6098-2205	01121	BB, 2 kilohms, ±5%	5905-686-3370
R31	Comp., 56 kilohms, ±5% 1/8 W	6098-3565	01121	BB, 56 kilohms, ±5%	5905-800-0179
R32	Comp., 5.6 kilohms, ±5% 1/8 W	6098-2565	01121	BB, 5.6 kilohms, ±5%	5905-691-0195
R33	Comp., 680 ohms, ±5% 1/4 W	6099-1685	01121	RCR07G-681J	
R34	Comp., 2.2 kilohms, ±5% 1/8 W	6098-2225	01121	BB, 2.2 kilohms, ±5%	
R35	Comp., 27 kilohms, ±5% 1/8 W	6098-3275	01121	BB, 27 kilohms, ±5%	
R36	Comp., 56 kilohms, ±5% 1/8 W	6098-3565	01121	BB, 56 kilohms, ±5%	5905-800-0179
R37	Comp., 3.3 kilohms, ±5% 1/8 W	6098-2335	01121	BB, 3.3 kilohms, ±5%	5905-681-9969
R38	Comp., 2 kilohms, ±5% 1/8 W	6098-2205	01121	BB, 2 kilohms, ±5%	5905-686-3370
R39	Comp., 3.3 kilohms, ±5% 1/8 W	6098-2335	01121	BB, 3.3 kilohms, ±5%	5905-681-9969
R40	Comp., 56 kilohms, ±5% 1/8 W	6098-3565	01121	BB, 56 kilohms, ±5%	5905-800-0179
R41	Comp., 5.6 kilohms, ±5% 1/8 W	6098-2565	01121	BB, 5.6 kilohms, ±5%	5905-691-0195
R42	Comp., 680 ohms, ±5% 1/4 W	6099-1685	75042	RCR07G-681J	
R43	Comp., 2.2 kilohms, ±5% 1/8 W	6098-2225	01121	BB, 2.2 kilohms, ±5%	
R44	Comp., 27 kilohms, ±5% 1/8 W	6098-3275	01121	BB, 27 kilohms, ±5%	
R45	Comp., 56 kilohms, ±5% 1/8 W	6098-3565	01121	BB, 56 kilohms, ±5%	5905-800-0179
R46	Comp., 100 ohms, ±5% 1/4 W	6099-1105	01121	RCR07G-101J	
TRANSISTORS					
Q1 and					
Q2	Type 2N4125	8210-1125	04713	2N4125	
Q3	Type 2N2369	8210-1052	96214	2N2369	5960-682-7755
Q4 and					
Q5	Type 2N4125	8210-1125	04713	2N4125	
Q6	Type 2N2369	8210-1052	96214	2N2369	5960-682-7755
Q7 and					
Q8	Type 2N4125	8210-1125	04713	2N4125	
Q9	Type 2N2369	8210-1052	96214	2N2369	5960-682-7755
Q10 and					
Q11	Type 2N4125	8210-1125	04713	2N4125	
Q12	Type 2N2369	8210-1052	96214	2N2369	5960-682-7755
Q13 and					
Q14	Type 2N4125	8210-1125	04713	2N4125	
Q15	Type 2N2369	8210-1052	96214	2N2369	5960-682-7755

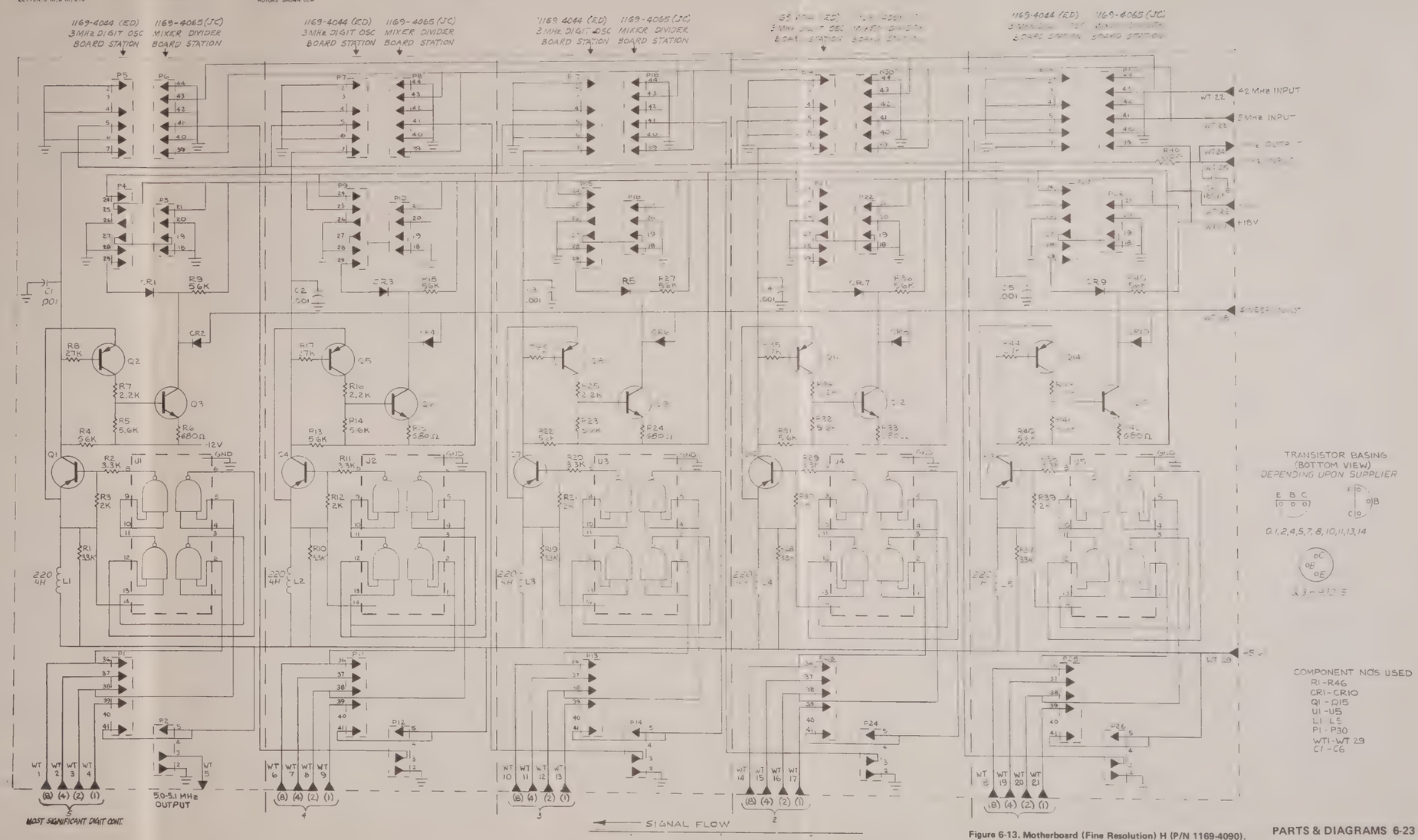


Figure 6-13. Motherboard (Fine Resolution) H (P/N 1169-4090).

ELECTRICAL PARTS LIST

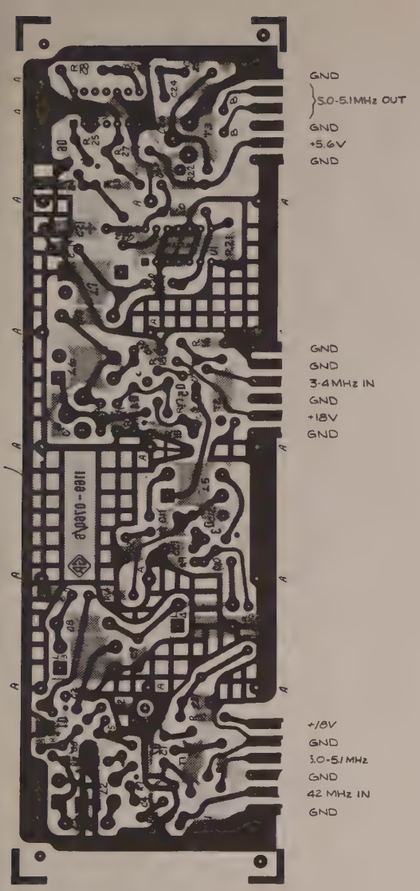
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4060 MIX/DIV CIRCUIT ASM (JA)					
CAPACITORS					
C1	Mica, 169 pF ±2% 500 V	4700-0443	72136	DM-15, 169 pF ±2%	
C2	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C3	Cer., 91 pF ±5% 100 V N030	4411-2000	72982	815-003-BIG0910J	
C4	Cer., 1000 pF ±10% 500 V	4405-2108	72982	801, 1000 pF ±10%	
C5	Cer., .0047 uF ±20%	4405-2470	72982	801, .0047 uF ±20%	
C6	Cer., .01 uF +80-20%	4401-3100	72982	805, .01 uF +80-20%	
C7	Cer., 68 pF ±5% 100 V N150	4413-1000	72982	8131, 68 pF ±5%	
C8	Cer., .22 pF ±5% 500 V	4400-0022	78488	GA, .22 pF ±5%	
C9	Cer., 68 pF ±5% 100 V N150	4413-1000	72982	0855037P2C-00680J	
C10	Cer., 2.2 pF ±10% 500 V N030	4411-9225	72982	811, 2.2 pF ±10%	
C11	Cer., 68 pF ±5% 100 V N150	4413-1000	72982	0855037P2C-00680J	
C12	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C13 and C14	Cer., 330 pF ±5% 500 V	4404-1335	72982	831, 330 pF ±5%	
C15	Cer., 27 pF ±5% 100 V N030	4411-2007	72982	835, 27 pF ±5%	
C16	Cer., 5.5-18 pF	4910-2031	72982	538-006, 5.5 pF	
C17	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C18	Cer., 2.7 pF ±10% 500 V	4400-0279	78488	GA, 2.7 pF ±10%	
C19	Cer., 56 pF ±5% 100 V N030	4412-0565	09392	56 pF, ±5%	
C20	Cer., 6.8 pF 500 V N030	4411-9685	09392	831, 6.8 pF ±5%	
C21	Tant., 3.3 uF ±20% 5 V	4450-4600	56289	150D335X0015A	5910-837-9325
C22	Cer., .01 uF +80-20%	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C23	Tant., 3.3 uF ±20% 5 V	4450-4600	56289	150D335X0015A	5910-837-9325
C24	Mica, 261 pF 1% 500 V	4710-0441	72136	DM-15, 261 pF ±1%	
C25	Mica, 270 pF ±1% 500 V	4710-0450	72136	DM-15, 270 pF ±1%	
C26	Cer., 7-25 pF N300	4910-2032	72982	538-006, 7-25 pF	5910-998-1621
C27 and C28	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
INDUCTORS					
L1	Molded, 12 uH	4300-7525	99800	1025, 12 uH	
L2	Asm (BU)	1165-2405	24655	1165-2405	
L3	Asm, (RD)	1165-2410	24655	1165-2410	
L4	Asm, (VT)	1165-2415	24655	1165-2415	
L5	Asm, (YE-RD)	1165-2411	24655	1165-2411	
L6	Asm, (BK)	1165-2470	24655	1165-2470	
L7	Asm, (VT)	1165-2415	24655	1165-2415	
INTEGRATED CIRCUITS					
U1	Digital, Type MC1013P	5431-9610	80211	MC1013P	
U2	Digital, Type SN74196N	5431-8096	96214	SN74196N	
RESISTORS					
R1	Comp., 220 ohms, ±5% 1/4 W	6099-1225	01121	RCR07G-221J	5905-683-2240
R2	Comp., 47 ohms, ±5% 1/4 W	6099-0475	01121	RCR07G-470J	
R3	Comp., 1.2 kilohms, ±5% 1/4 W	6099-2125	01121	RCR07G-122J	
R4	Comp., 620 ohms, ±5% 1/4 W	6099-1625	01121	RCR07G-621J	5905-801-6998

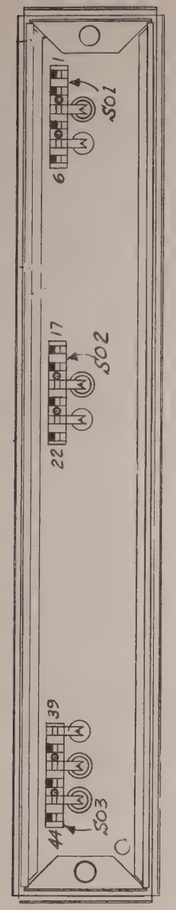
ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
RESISTORS (cont)					
R5	Comp., 150 ohms, ±5% 1/4 W	6099-1155	01121	RCR07G-151J	5905-683-2243
R6	Comp., 18 kilohms, ±5% 1/4 W	6099-3185	01121	RCR07G-183J	5905-687-0000
R7	Comp., 3.3 kilohms, ±5% 1/4 W	6099-2335	01121	RCR07G-332J	5905-681-9969
R8	Comp., 470 ohms, ±5% 1/4 W	6099-1475	01121	RCR07G-471J	5905-683-2242
R9	Comp., 1.8 kilohms, ±5% 1/4 W	6099-2185	01121	RCR07G-182J	5905-688-3738
R10	Comp., 13 kilohms, ±5% 1/4 W	6099-3135	01121	RCR07G-133J	
R11	Comp., 150 ohms, ±5% 1/4 W	6099-1155	01121	RCR07G-151J	5905-683-2243
R12	Pot Cermet, 500 ohms, ±10%	6049-0294	01121		
R13	Comp., 51 ohms, ±5% 1/4 W	6099-0515	01121	RCR07G-510J	
R14	Comp., 470 ohms, ±5% 1/4 W	6099-1475	01121	RCR07G-471J	5905-683-2242
R15 and R16	Comp., 6.8 kilohms, ±5% 1/4 W	6099-2685	01121	RCR07G-682J	5905-686-9997
R17	Comp., 1.5 kilohms, ±5% 1/4 W	6099-2155	01121	RCR07G-152J	
R18	Comp., 1.0 kilohms, ±5% 1/4 W	6099-2105	01121	RCR07G-102J	5905-681-6422
R19	Comp., 470 ohms, ±5% 1/4 W	6099-1475	01121	RCR07G-471J	5905-683-2242
R20	Comp., 680 ohms, ±5% 1/4 W	6099-1685	01121	RCR07G-681J	
R21	Comp., 2.7 kilohms, ±5% 1/4 W	6099-2275	01121	RCR07G-272J	
R22	Comp., 18 ohms, ±5% 1/4 W	6099-0185	01121	RCR07G-180J	
R23	Comp., 1.8 kilohms, ±5% 1/4 W	6099-2185	01121	RCR07G-182J	5905-688-3738
R24	Comp., 390 ohms, ±5% 1/4 W	6099-1395	01121	RCR07G-391J	
R25	Comp., 680 ohms, ±5% 1/4 W	6099-1685	01121	RCR07G-681J	
R27	Comp., 10 ohms, ±5% 1/4 W	6099-0105	01121	RCR07G-100J	5905-809-8596
R28	Comp., 2.2 kilohms, ±5% 1/4 W	6099-2225	01121	RCR07G-222J	5905-723-5251
R29	Comp., 1.5 kilohms, ±5% 1/4 W	6099-2155	01121	RCR07G-152J	
TRANSFORMERS					
T1	Asm	1160-2610	24655	1160-2610	
T2	Asm	1160-2613	24655	1160-2613	
T3	Asm	1160-2611	24655	1160-2611	
TRANSISTORS					
Q1	Type 2N3905	8210-1114	04713	2N3905	
Q2 and Q3	Type 2N3563	8210-1066	07263	2N3563	
Q4 and Q5	Type 2N3903	8210-1132	04713	2N3903	
Q6	Type 2N4275	8210-1126	07263	2N4275	
1169-4065 MIXER/DIVIDER CIRCUIT ASM (JC)					
All parts the same as 1169-4060					

ELECTRICAL PARTS LIST (cont)

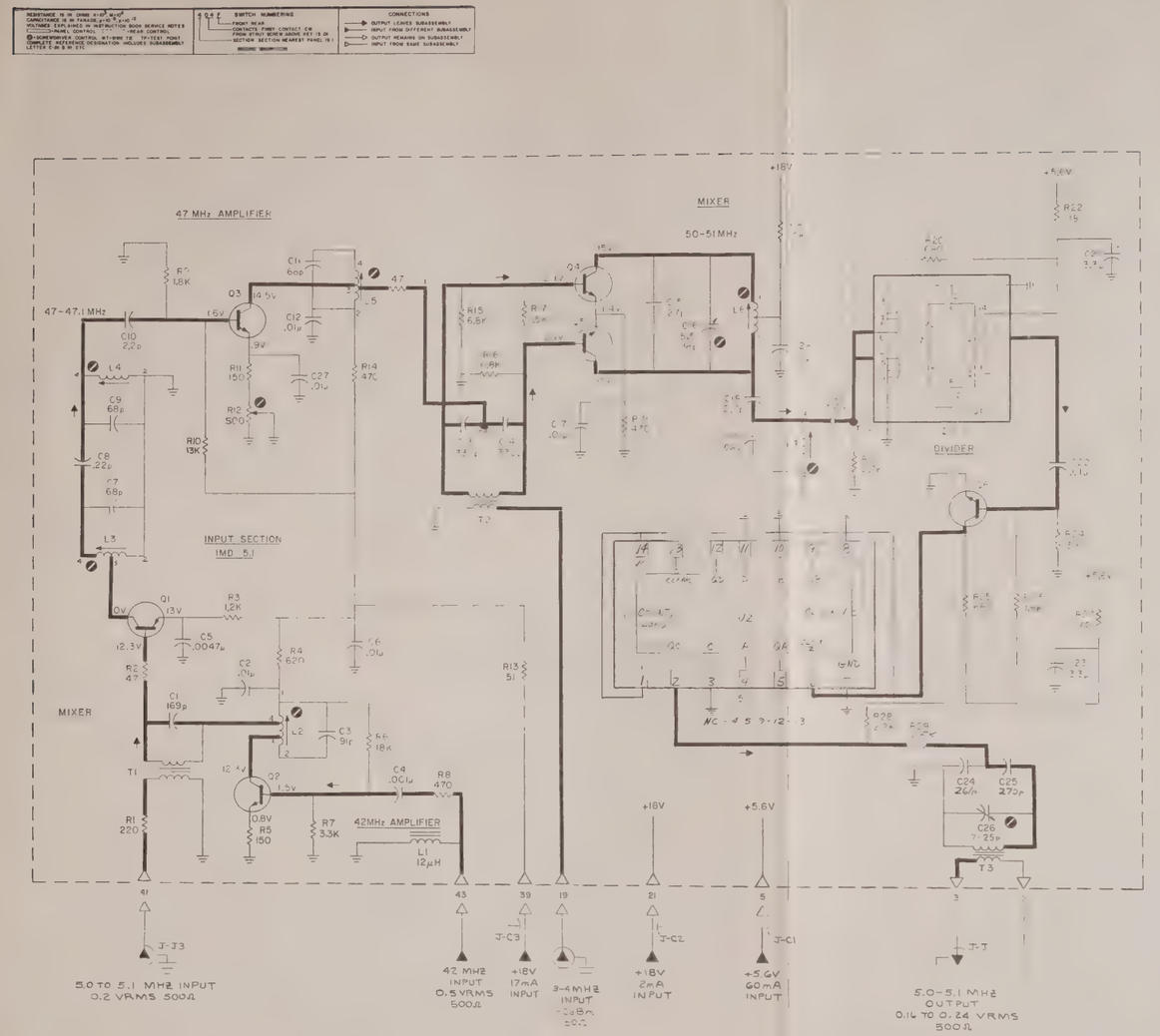
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1165-2026 ENCLOSURE BASE (J)					
CAPACITORS					
J-C1 thru J-C3	Cer., 1000 pF +100-0% 500 V	4400-2200	01121	FASC, 1000 pF +100-0%	
CONNECTORS					
J-J1 thru J-J4	RF Inserts	1165-6020	24655	1165-6020	
S01 and S02	Contact Strip asm.	1165-1823	24655	1165-1823	
S03	Contact Strip asm.	1165-1831	24655	1165-1831	

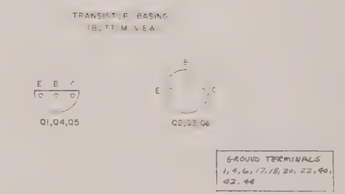




Etched-circuit diagram, Mixer/Divider board – JA (P/N 1169-4060).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.





NOTE: FOR 1169-4065 CIRCUIT DESIGNATION IS JC

FOR 1169-4065 APPLICATION, SEE DRAWINGS 1169-4090-2D AND 1169-4092 FOR MATING CONNECTIONS.

Figure 6-14. 5.1 MHz Inter. Mixer JA and JC (P/N 1169-4060/ -4065).

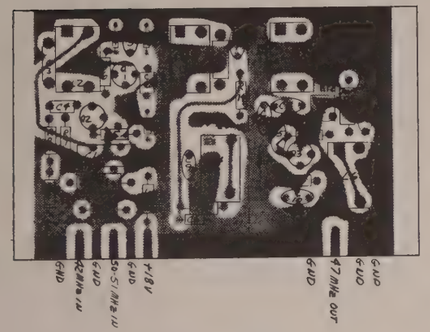
ELECTRICAL PARTS LIST

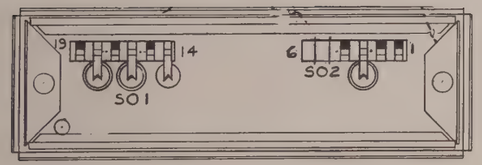
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1165-4018 INPUT MIXER CIRCUIT ASM (LA)					
CAPACITORS					
C1	Mica, 169 pF ±2† 500 V	4700-0443	14655	22A5TI5, 167 pF ±2%	
C2	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	
C3	Cer., 91 pF ±5% 100 V N030	4411-2000	72982	815, 91 pF ±5%	
C4	Cer., 1000 pF ±5% 500 V	4405-2105	72982	801, 1000 pF ±5%	
C5	.0047 uF ±20%	4405-2470	72982	801, .0047 uF ±20%	
C6	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	
C7	Cer., 68 pF ±5% 100 V N150	4413-1000	72982	0855037P20-006801	
C8	Cer., 1.2 pF ±5% 500 V	4400-0120	78488	GA, 1.2 pF ±5%	
C9	Cer., 68 pF ±5% 100 V N150	4413-1000	72982	0855037P20-00680J	
C10	Cer., 3.3 pF ±5% 100 V NPO	4410-1200	72982	865, 3.3 pF ±5%	
C11	Cer., 68 pF ±5% 100 V N150	4413-1000	72982	0855037P20-00680J	
C12	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	
C13	Cer., 68 pF ±5% 100 V N150	4413-1000	72982	0855037P20-00680J	
C14	Cer., .68 pF ±10% 500 V	4400-0068	78488	GA, .68 pF ±10%	
C15	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	
INDUCTORS					
L1	Molded, 12 uH ±10%	4300-7525	99800	1025, .12 uH ±10%	
L2	Asm (BU)	1165-2405	24655	1165-2405	
L3	Adjust, (RD)	1165-2410	24655	1165-2410	
L4	Adjust, (VT)	1165-2415	24655	1165-2415	
L5	Adjust, (RD)	1165-2410	24655	1165-2410	
L6	Adjust, (GN)	1165-2425	24655	1165-2425	
L7	Molded, 8.2 uH ±10%	4300-7558	99800	1025-42, 8.2 uH ±10%	
RESISTORS					
R1	Comp., 390 ohms, ±5% 1/4 W	6099-1395	01121	RCR07G-391J	
R2	Comp., 51 ohms, ±5% 1/8 W	6098-0515	01121	RCR05G-510J	
R3	Comp., 1.2 kilohms, ±5% 1/8 W	6098-2125	01121	RCR05G-122J	
R4	Comp., 620 ohms, ±5% 1/8 W	6098-1625	01121	RCR05G-621J	
R5	Comp., 150 ohms, ±5% 1/4 W	6099-1155	01121	RCR07G-151J	5905-683-2243
R6	Comp., 18 kilohms, ±5% 1/4 W	6099-3185	01121	RCR07G-183J	5905-687-0000
R7	Comp., 3.3 kilohms, ±5% 1/4 W	6099-2335	01121	RCR07G-332J	5905-681-9969
R8	Comp., 390 ohms, ±5% 1/4 W	6099-1395	01121	RCR07G-391J	
R9	Comp., 1.8 kilohms, ±5% 1/4 W	6099-2185	01121	RCR07G-182J	5905-688-3738
R10	Comp., 15 kilohms, ±5% 1/4 W	6099-3155	01121	RCR07G-153J	5905-681-8818
R11	Comp., 120 ohms, ±5% 1/4 W	6099-1125	01121	RCR07G-121J	
R12	Pot. cermet, 200 ohms, ±10%	6049-0293	01121	ZH2011	
R14	Comp., 470 ohms, ±5% 1/4 W	6099-1475	01121	RCR07G-471J	
TRANSFORMERS					
T1	Transformer Asm	1160-2610	24655	1160-2610	
TRANSISTORS					
Q1	Type 2N3905	8210-1114	04713	2N3905	
Q2	Type 2N3563	8210-1066	07263	2N3563	
Q3	Type 2N5179	8210-1195	79089	2N5179	

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1165-2031 ENCLOSURE BASE (L)					
CAPACITOR					
L-C1	Cer., 1000 pF +100-0% 500 V	4400-2200	01121	FA5C, 1000 pF ±100-0%	
CONNECTORS					
L-J1 thru					
L-J3	RF Inserts	1165-6020	24655	1165-6020	
S01	Contact Strip	1165-1831	24655	1165-1831	
S02	Contact Strip	1165-1816	24655	1165-1816	

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is not shown. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.



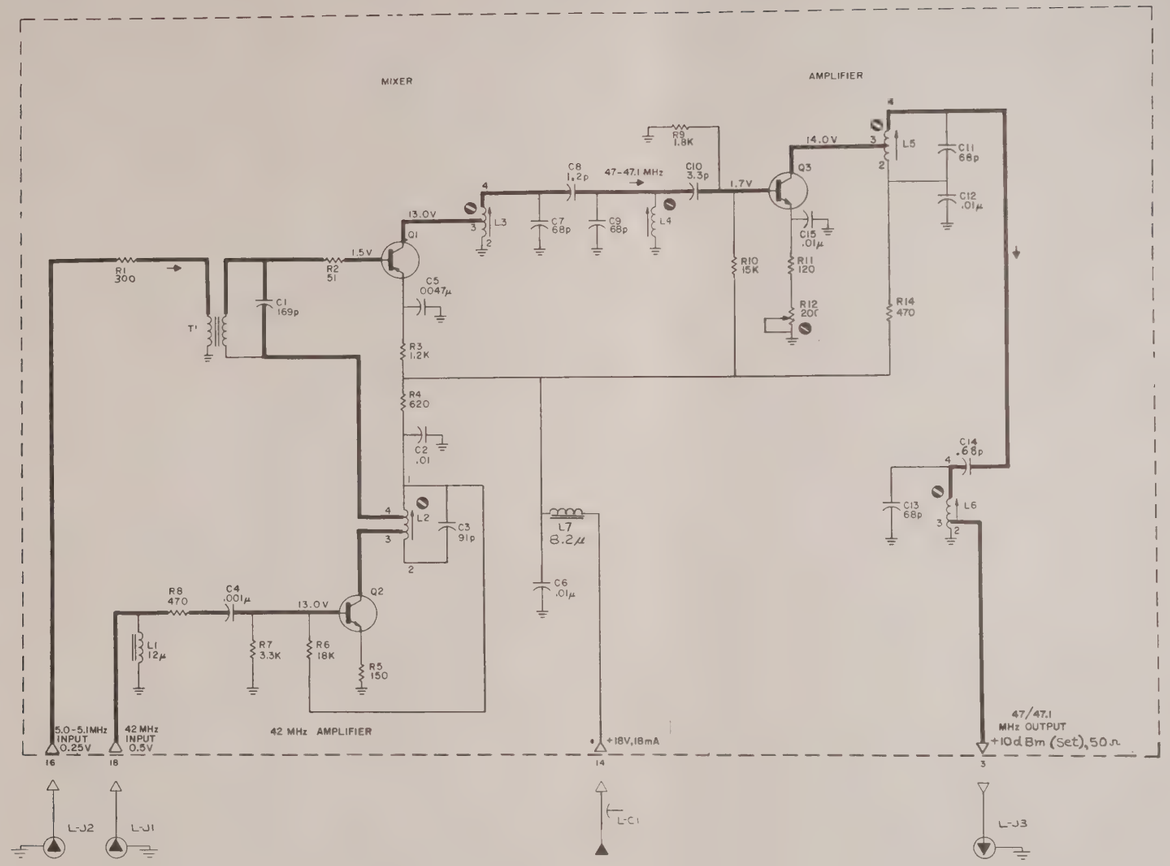


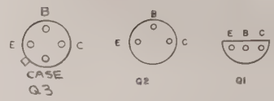
Etched-circuit diagram, input mixer circuit — LA (P/N 1169-4018).

RESISTANCE IS IN OHMS, K=10^3, M=10^6
CAPACITANCE IS IN FARADS, μ=10^{-6}, p=10^{-12}
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
⟵ = PANEL CONTROL ⟶ = REAR CONTROL
② = SCREWDRIVER CONTROL WT = WIRE TIE TP = TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER, C-A1 B-A1, ETC

SWITCH NUMBERING
4 0 4 F
FRONT, REAR
CONTACTS, FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS 01.
SECTION. SECTION NEAREST PANEL IS 1.
ROTORS SHOWN CCW

CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY



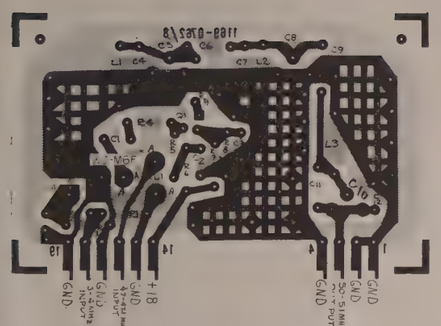


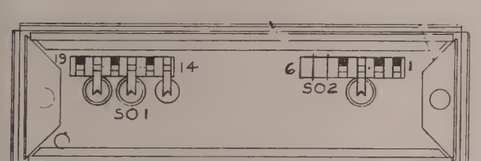
GROUND TERMINALS
1, 2, 4, 15, 17, 19

Figure 6-15. Intermediate Mixer (47-MHz) LA (P/N 1165-4018).

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4062 INTERMEDIATE MIXER BOARD (MB)					
CAPACITORS					
C1 thru C3	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C4	Cer., 51 pF ±5% 500 V N030	4411-0515	72982	801, 51 pF ±5%	
C5	Trimmer, 7-25 pF	4910-2032	72982	538-006, 7 to 25 pF	5910-998-1621
C6	Cer., 2.2 pF ±5% 500 V	4400-0205	78488	GA, 2.2 pF ±5%	5910-667-6114
C7	Cer., 51 pF ±5% 500 V N030	4411-0515	72982	811, 68 pF ±5%	
C8	Trimmer, 7-25 pF	4910-2032	72982	528-006, 7 to 25 pF	5910-998-1621
C9	Cer., 1.5 pF ±5% 500 V	4400-0150	78488	GA, 1.5 pF ±5%	
C10	Trimmer, 7-25 pF	4910-2032	72982	538-006, 7 to 25 pF	5910-998-1621
C11	Cer., 68 pF ±5% 500 V N030	4411-0685	72982	811, 68 pF ±5%	
C12	Mica, 270 pF ±1% 500 V	4710-0450	14655	22A, 270 pF ±1%	
INDUCTORS					
L1 thru L3	Molded, 0.15 uH ±10%	4300-0101	99800	1537.00	
INTEGRATED CIRCUITS					
U1	Mixer, Type M6F	5434-0100	23367	M6F	
RESISTORS					
R1	Comp., 220 ohms, ±5% 1/4 W	6099-1225	01121	RCR07G-221J	5905-683-2240
R2	Comp., 24 ohms, ±5% 1/4 W	6099-0245	01121	RCR07G-240J	
R3	Comp., 220 ohms, ±5% 1/4 W	6099-1225	01121	RCR07G-221J	5905-683-2240
R4	Comp., 39 ohms, ±5% 1/4 W	6099-0395	01121	RCR07G-390J	
R5	Comp., 1 kilohm, ±5% 1/4 W	6099-2105	01121	RCR07G-102J	5905-681-6422
R6	Comp., 470 ohms, ±5% 1/4 W	6099-1475	01121	RCR07G-471J	5905-683-2242
R7	Comp., 10 kilohms, ±5% 1/4 W	6099-3105	01121	RCR07G-103J	5905-683-2288
R8	Comp., 8.2 kilohms, ±5% 1/4 W	6099-2825	01121	RCR07G-822J	
R9	Comp., 47 ohms, ±5% 1/4 W	6099-0475	01121	RCR07G-470J	
TRANSISTOR					
Q1	Type 2N3905	8210-1114	04713	2N3905	
1165-2031 ENCLOSURE BASE					
CAPACITOR					
M-C1	Cer., 1000 pF ±100-0% 500 V	4400-2200	01121	FA5C, 1000 pF +100-0%	
CONNECTORS					
M-J1 thru M-J3	RF Inserts	1165-6020	24655	1165-6020	
S01	Contact Strip	1165-1831	24655	1165-1831	
S02	Contact Strip	1165-1816	24655	1165-1816	





Etched-circuit diagram, Intermediate mixer board – MB (P/N 1169-4062).

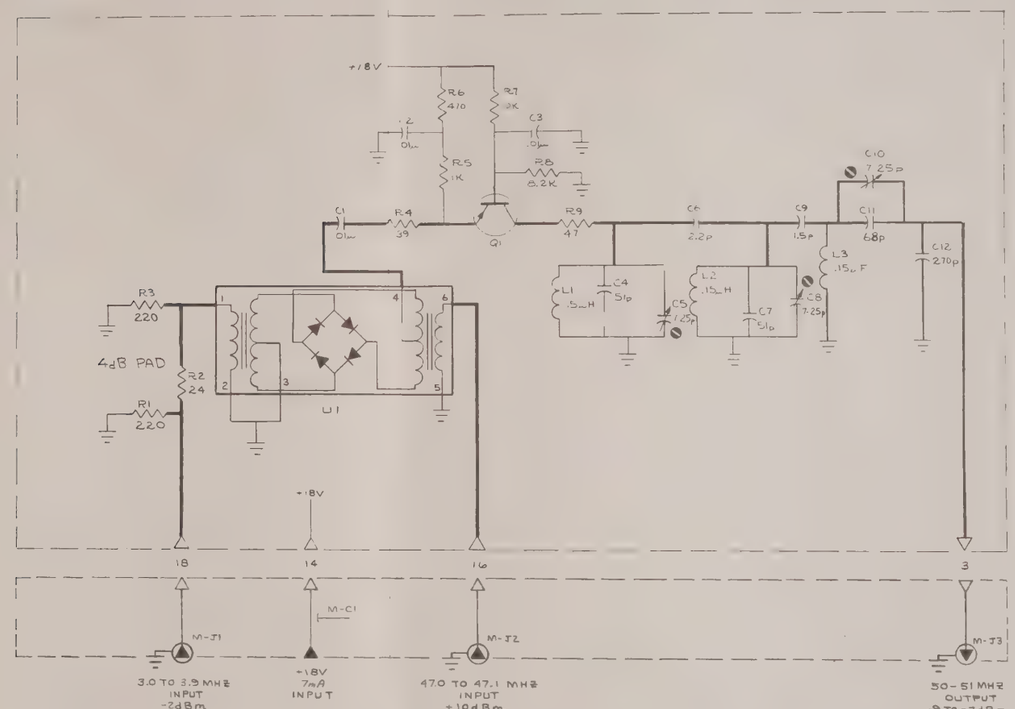
NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

RESISTANCE IS IN OHMS, K=10^3, M=10^6
CAPACITANCE IS IN FARADS, μ=10^{-6}, p=10^{-12}
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
□ PANEL CONTROL ▭▭▭ REAR CONTROL
SCREWDRIVER CONTROL WT=WIRE TIE TP=TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER, C-R1, B R1, ETC

S 0 4 F SWITCH NUMBERING
FRONT, REAR
CONTACTS, FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS 01
SECTION, SECTION NEAREST PANEL IS 1
ROTORS SHOWN CCW

CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY

ALL FEED-THROUGH CAPACITORS ARE GROUNDED TO ENCLOSURE AND ARE 1000 pF



TRANSISTOR BASING (BOTTOM VIEW)

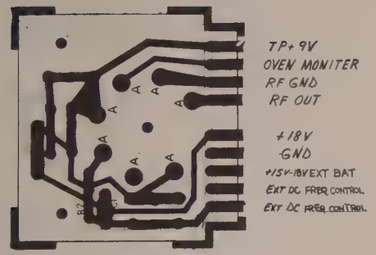
COMPONENTS USED:
CAPACITORS : C1 THRU C12
INDUCTORS : L1, L2, L3
RESISTORS : R1 THRU R9
TRANSISTOR: Q1
INTEGRATED CIRCUIT: U1

GROUND CONTACTS USED
1, 2, 4, 15, 17, 19

Figure 6-16. Intermediate mixer (51 MHz) MB (P/N 1169-4062).

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4033 MASTER OSCILLATOR UNIT ASM (MO-10B)					
OSCILLATOR ASM		1158-4010	24655	1158-4010	
MASTER OSCILLATOR BOARD		1169-4032	24655	1169-4032	
CAPACITORS					
C1	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	
DIODES					
CR1 and CR2	Type 1N645	6082-1016	24446	1N645	5961-087-6047
RESISTORS					
R1 and R2	Comp., 1 kilohm, ±5% 1/4 W	6099-2105	01121	RCR07G-102J	5905-681-6422
R3	Film, 1 kilohm, ±1% 1/8 W	6250-1100	75042	CEA, 1 kilohm, ±1%	5905-681-6915
R4	Film, 7.87 kilohms, ±1% 1/8 W	6250-1787	75042	CEA, 7.87 kilohms, ±1%	5905-800-7816
R5	Film, 820 ohms, ±1% 1/8 W	6250-0820	75042	CEA, 820 ohms, ±1%	
1169-4131 MODERATE STABILITY UNIT (MO-10C) ROOM TEMPERATURE					
OSCILLATOR ASM		1169-4131	24655	1169-4131	
MASTER OSCILLATOR BOARD		1169-4032	24655	1169-4032	
CAPACITORS					
C1	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	
DIODES					
CR1 and CR2	Type 1N645	6082-1016	24446	1N645	
RESISTORS					
R1 and R2	Comp., 1 kilohm, ±5% 1/4 W	6099-2105	01121	RCR07G-102J	5905-681-6422
R3	Film, 1 kilohm, ±1% 1/8 W	6250-1100	75042	CEA, 1 kilohm, ±1%	5905-681-6915
R4	Film, 7.87 kilohm ±1% 1/8 W	6250-1787	75042	CEA, 7.87 kilohms, ±1%	5905-800-7816
R5	Film, 820 ohms, ±1% 1/8 W	6250-0820	75042	CEA, 820 ohms, ±1%	



Etched-circuit diagram, Master oscillator unit

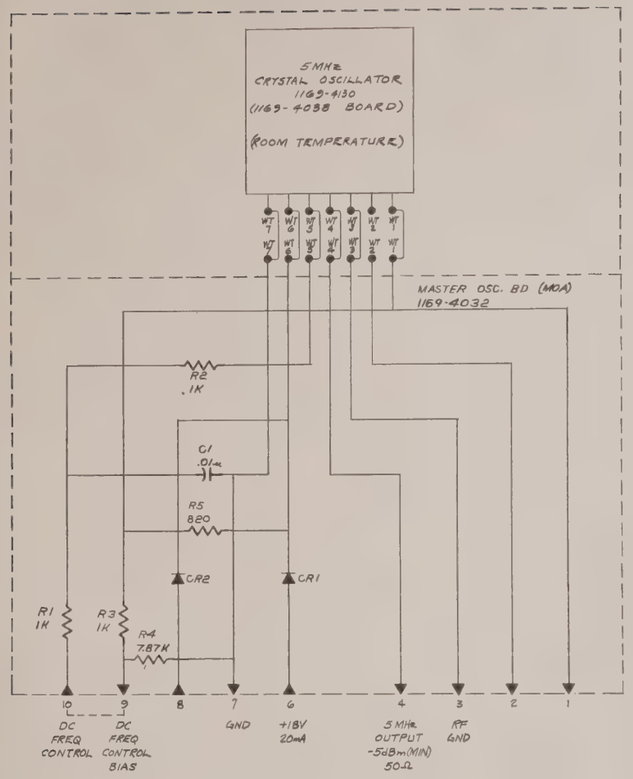
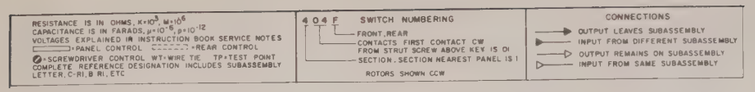


Figure 6-17. Part 1 — Moderate stability oscillator unit MO-10C (P/N 1169-4131).


RESISTANCE IS IN OHMS, K=10³, M=10⁶
CAPACITANCE IS IN FARADS, μ=10⁻⁶, p=10⁻¹²
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
PANEL CONTROL
REAR CONTROL
SCREWDRIVER CONTROL WT-WIRE TIE TP-TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER, C-R1, B R1, ETC
4 0 4 F SWITCH NUMBERING
FRONT, REAR
CONTACTS FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS 01
SECTION, SECTION NEAREST PANEL IS 1
ROTORS SHOWN CCW
CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY

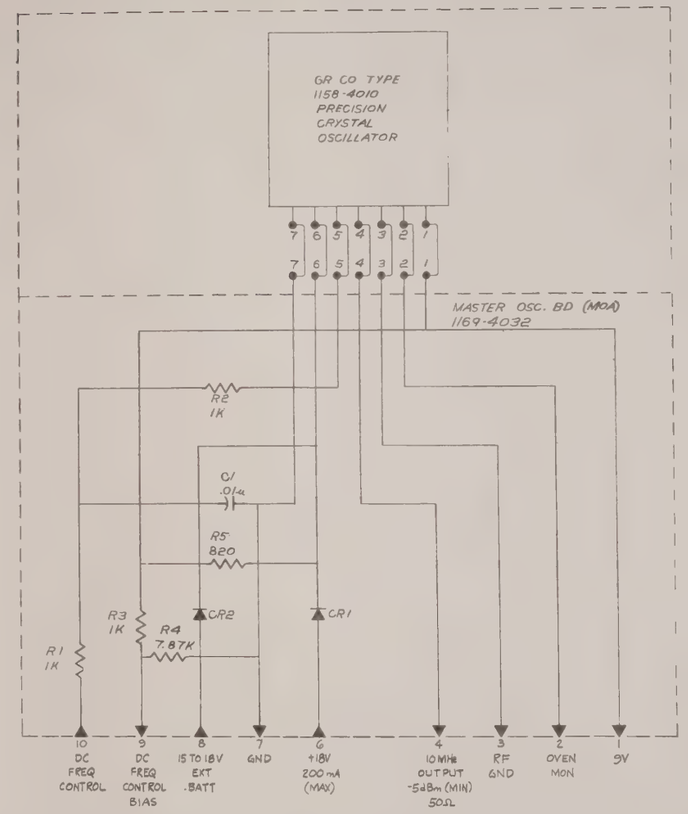


Figure 6-17. Part 2 — High stability Master oscillator unit MO-10B (P/N 1169-4033).

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
	1169-4052 500 MHz OUTPUT AMPLIFIER (OAC)				
	CAPACITORS				
C1	Ceramic, 1.0 µF, ±20%, 50 V	4400-2070	80183	5C13, 1.0 µF, ±20%	
C2	Tantalum, 4.7 µF, ±20%, 25 V	4450-6531	56289	150D, 4.7 µF, ±20%	
C3	Ceramic, 0.22 µF, ±20%, 50 V	4400-2052	80183	5C13, 0.22 µF, ±20%	5910-974-5694
C4	Ceramic, 13 pF, ±5%, N030	4411-0135	80131	CC61, 13 pF, ±5%	
C5	Ceramic, 9.1 pF, ±5%, N030	4411-9915	80131	CC60, 9.1 pF, ±5%	
C6	Ceramic, 0.22 µF, ±20%, 50 V	4400-2052	80183	5C13, 0.22 µF, ±20%	5910-974-5694
C7 and C8	Tantalum, 4.7 µF, ±20%, 25 V	4450-6531	56289	150D, 4.7 µF, ±20%	
C9	Trimmer, Ceramic, 3.5-13 pF	4910-2071	72982	TS-TRIKO-02	
C10	Ceramic, 0.22 µF, ±20%, 50 V	4400-2052	80183	5C13, 0.22 µF, ±20%	5910-974-5694
C11	Tantalum, 4.7 µF, ±20%, 25 V	4450-6531	56289	150D, 4.7 µF, ±20%	
C12	Ceramic, 0.22 µF, ±20%, 50 V	4400-2052	80183	5C13, 0.22 µF, ±20%	5910-974-5694
C13	Ceramic, 10 pF, ±5%, N030	4411-0105	72982	801, 10 pF, ±5%	
C15	Trimmer, Ceramic, 3.5-13 pF	4910-2071	72982	TS-TRIKO-02	
C16	Ceramic, 1000 pF, +100-0%, 300 V	4400-5700	00656	BC-C1-2-NM	
C17	Tantalum, 6.8 µF, ±20%, 20 V	4450-6530	56289	150D, 6.8 µF, ±20%	
C18 and C19	Tantalum, 4.7 µF, ±20%, 25 V	4450-6531	56289	150D, 4.7 µF, ±20%	
C20	Ceramic, 0.47 µF, ±20%, 50 V	4400-2054	80183	5C13, 0.47 µF, ±20%	
C21 and C22	Ceramic, Feed-Thru, 220 pF, ±10%	4400-2103	01121	FA5C, 220 pF, ±10%	
C23 and C24	Ceramic, 220 pF, ±5%, 500 V	4404-1225	72982	831, 220 pF, ±5%	
C25 and C26	Ceramic, 0.0018 µF, ±10%, 50 V	4400-6359	72982	8121-M050-W5R-182K	
C27 and C28	Ceramic, 0.022 µF, ±10%, 50 V	4400-6353	72982	8131-M050-W5R-223K	
C29	Ceramic, 27 pF, ±10%, 500 V	4404-0278	72982	831, 27 pF, ±5%	
C30	Tantalum, 6.8 µF, ±20%, 6 V	4450-4800	56289	150D685X0010A2	5910-936-1332
C31	Ceramic, 27 pF, ±10%, 500 V	4404-0278	72982	831, 27 pF, ±5%	
C32	Ceramic, 0.0018 µF ±10% 50 V	4400-6359	72982	8121-M050-W5R-182K	
C33	Ceramic, 1000 pF, ±5%, 500 V	4405-2105	72982	801, 10 pF, ±5%	
C34	Ceramic, 8.2 pF, ±5%, N030	4411-9825	80131	CC60, 8.2 pF, ±5%	
C35	Ceramic, 10 pF, ±5%, N030	4411-0105	72982	801, 10 pF, ±5%	
C36	Ceramic, 5.1 pF, ±5%, 500 V, N030	4411-9515	80131	CC60, 5.1 pF, ±5%	
C37	Ceramic, 0.022 µF, ±10%, 50 V	4400-6353	72982	8131-M050-W5R-223K	
C38	Ceramic 0.1 µF ±10% 100V	4400-6350	72982	8131-M100-W5R-104K	
C39	Ceramic, 1000 pF ±5%, 500 V	4405-2105	72982	801, 1000 pF ±5%	
	CHOKES				
L1	Molded, 0.22 µH, ±10%	4300-7551	99800	1025 0.22 µH ±10%	
L2	Molded, 0.1 µH, ±10%	4300-7555	99800	1537, 0.1 µH, ±10%	
L5	Molded 22 µH ±10%	4300-7527	99800	1025 22 µH ±10%	
	CONNECTORS				
J2	Cable Asm.	1169-2584	24655	1169-2584	
	DIODES				
CR1 and CR2	Type 5082-2811	6082-1045	90952	5082-2811	
CR3 and CR4	Type IN3604	6082-1001	24446	IN3604	5961-995-2199
	FERRITE BEADS				
L3 and L4	Ferrite Bead	5000-1250	02114	56-590-65/4B	
	INTEGRATED CIRCUITS				
U1 and U2	Linear Type LM301A	5432-1004	12040	LM301A	
	RESISTORS				
R1	Comp., 510 Ω, ±5%, 1/8 W	6098-1515	01121	BB, 510 Ω, ±5%	
R2	Comp., 3.6 k Ω, ±5%, 1/8 W	6098-2365	01121	BB, 3.6 k Ω, ±5%	
R3	Comp., 120 Ω, ±5%, 1/8 W	6098-1125	01121	BB, 120 Ω, ±5%	
R4	Comp., 270 Ω, ±5%, 1/4 W	6099-1275	75042	BTS, 270 Ω, ±5%	
R5	Comp., 120 Ω, ±5%, 1/8 W	6098-1125	01121	BB, 120 Ω, ±5%	

ELECTRICAL PARTS LIST (cont)

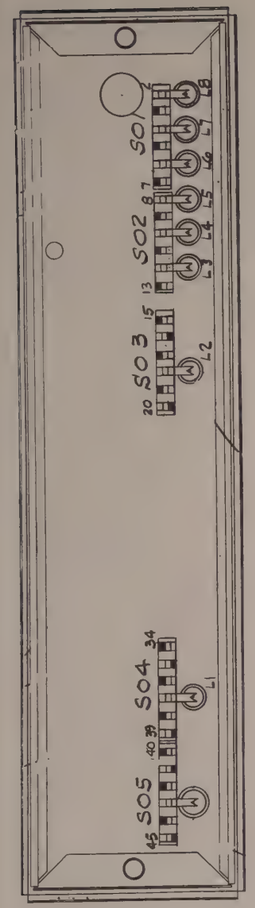
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
	RESISTORS (Cont)				
R6	Comp., 24 Ω, ±5%, 1/8 W	6098-0245	01121	BB, 24 Ω, ±5%	
R7	Comp., 510 Ω, ±5%, 1/8 W	6098-1515	01121	BB, 510 Ω, ±5%	
R8	Comp., 3.6 kΩ, ±5%, 1/8 W	6098-2365	01121	BB, 3.6 kΩ, ±5%	
R9	Comp., 120 Ω, ±5%, 1/8 W	6098-1125	01121	BB, 120 Ω, ±5%	
R10	Comp., 24 Ω, ±5%, 1/8 W	6098-0245	01121	BB, 24 Ω, ±5%	
R11	Comp., 120 Ω, ±5%, 1/8 W	6098-1125	01121	BB, 120 Ω, ±5%	
R12	Comp., 270 Ω, ±5%, 1/4 W	6099-1275	75042	BTS, 270 Ω, ±5%	
R13	Comp., 510 Ω, ±5%, 1/8 W	6098-1515	01121	BB, 510 Ω, ±5%	
R14	Comp., 3.6 kΩ, ±5%, 1/8 W	6098-2365	01121	BB, 3.6 kΩ, ±5%	
R15	Comp., 120 Ω, ±5%, 1/8 W	6098-1125	01121	BB, 120 Ω, ±5%	
R16	Comp., 24 Ω, ±5%, 1/8 W	6098-0245	01121	BB, 24 Ω, ±5%	
R17	Comp., 120 Ω, ±5%, 1/8 W	6098-1125	01121	BB, 120 Ω, ±5%	
R18	Comp., 270 Ω, ±5%, 1/4 W	6099-1275	75042	BTS, 270 Ω, ±5%	
R19	Comp., 510 Ω, ±5%, 1/8 W	6098-1515	01121	BB, 510 Ω, ±5%	
R20	Comp., 3.6 kΩ, ±5%, 1/8 W	6098-2365	01121	BB, 3.6 kΩ, ±5%	
R21	Comp., 120 Ω, ±5%, 1/8 W	6098-1125	01121	BB, 120 Ω, ±5%	
R22	Comp., 12 Ω, ±5%, 1/8 W	6098-0125	01121	BB, 12 Ω, ±5%	
R23	Comp., 47 Ω, ±5%, 1/4 W	6099-0475	75042	BTS, 47 Ω, ±5%	
R24	Comp., 62 Ω, ±5%, 1/4 W	6099-0625	75042	BTS, 62 Ω, ±5%	
R25	Comp., 75 Ω, ±5%, 1/8 W	6098-0755	01121	BB, 75 Ω, ±5%	
R26	Comp., 390 Ω, ±5%, 1/8 W	6098-1395	01121	BB, 390 Ω, ±5%	
R27	Comp., 33 Ω, ±5%, 1/8 W	6098-0335	01121	BB, 33 Ω, ±5%	
R28 and R29	Comp., 4.7 Ω, ±5%, 1/4 W	6099-9475	75042	BTS, 4.7 Ω, ±5%	
R30	Comp., 2.7 Ω, ±5%, 1/4 W	6099-9275	75042	BTS, 2.7 Ω, ±5%	
R31	Comp., 3.6 kΩ, ±5%, 1/4 W	6099-2365	75042	BTS, 3.6 kΩ, ±5%	5905-577-0627
R32 and R33	Comp., 180 Ω, ±5%, 1/2 W	6100-1185	01121	RC20GF181J	5905-279-3514
R34	Comp., 4.7 Ω, ±5%, 1/4 W	6099-9475	75042	BTS, 4.7 Ω, ±5%	
R35	Comp., 2.7 Ω, ±5%, 1/4 W	6099-9275	75042	BTS, 2.7 Ω, ±5%	
R36	Comp., 1 kΩ, ±5%, 1/8 W	6098-2105	01121	BB, 1 kΩ, ±5%	
R37	Film, 50 Ω, ±0.5%, 100 PPM	6619-3300	24655	6619-3300	
R38 and R39	Comp., 1 MΩ, ±5%, 1/8 W	6098-5105	01121	BB, 1 MΩ, ±5%	
R40	Comp., 10 kΩ, ±5%, 1/8 W	6098-3105	01121	BB, 10 kΩ, ±5%	
R41	Comp., 1 kΩ, ±5%, 1/8 W	6098-2105	01121	BB, 1 kΩ, ±5%	
R42	Comp., 47 kΩ, ±5%, 1/8 W	6098-3475	01121	BB, 47 kΩ, ±5%	
R43	Comp., 100 kΩ, ±5%, 1/8 W	6098-4105	01121	BB, 100 kΩ, ±5%	
R44	Comp., 47 kΩ, ±5%, 1/8 W	6098-3475	01121	BB, 47 kΩ, ±5%	
R45	Comp., 750 kΩ, ±5%, 1/8 W	6098-4755	01121	BB, 750 kΩ, ±5%	
R46 and R47	Comp., 1 MΩ, ±5%, 1/8 W	6098-5105	01121	BB, 1 MΩ, ±5%	
R48	Comp., 1 kΩ, ±5%, 1/8 W	6098-2105	01121	BB, 1 kΩ, ±5%	
R49	Comp., 47 kΩ, ±5%, 1/8 W	6098-3475	01121	BB, 47 kΩ, ±5%	
R50	Comp., 100 kΩ, ±5%, 1/8 W	6098-4105	01121	BB, 100 kΩ, ±5%	
R51	Comp., 47 kΩ, ±5%, 1/8 W	6098-3475	01121	BB, 47 kΩ, ±5%	
R52	Comp., 750 kΩ, ±5%, 1/8 W	6098-4755	01121	BB, 750 kΩ, ±5%	
R53	Comp., 33 Ω, ±5%, 1/8 W	6098-0335	01121	BB, 33 Ω, ±5%	
R54	Comp., 4.7 Ω, ±5%, 1/8 W	6098-9475	01121	BB, 4.7 Ω, ±5%	
R55	Comp., 100 kΩ, ±5%, 1/8 W	6098-4105	01121	BB, 100 kΩ, ±5%	
R56	Comp., 47 kΩ, ±5%, 1/8 W	6098-3475	01121	BB, 47 kΩ, ±5%	
R57	Comp., 1 kΩ, ±5%, 1/8 W	6098-2105	01121	BB, 1 kΩ, ±5%	
R58	Comp., 10 kΩ, ±5%, 1/8 W	6098-3105	01121	BB, 10 kΩ, ±5%	
R59	Comp., 1 MΩ, ±5%, 1/8 W	6098-5105	01121	BB, 1 MΩ, ±5%	
R60	Comp., 1 kΩ, ±5%, 1/8 W	6098-2105	01121	BB, 1 kΩ, ±5%	
R61 and R62	Comp., 470 Ω, ±5%, 1/8 W	6098-1475	01121	BB, 470 Ω, ±5%	
R63	Comp., 3.9 kΩ, ±5%, 1/8 W	6098-2395	01121	BB, 3.9 kΩ, ±5%	
R67	Comp., 10 kΩ, ±5%, 1/8 W	6098-3105	01121	BB, 10 kΩ, ±5%	
R68	Comp., 680 kΩ, ±5%, 1/8 W	6098-4685	01121	BB, 680 kΩ, ±5%	
R69	Film, 71.5 kΩ, ±1%, 1/8 W	6250-2715	75042	CEA, 71.5 kΩ, ±1%	
R70	Film, 28.7 kΩ, ±1%, 1/8 W	6250-2287	75042	CEA, 28.7 kΩ, ±1%	5905-691-0572
R71	Film, 66.5 kΩ, ±1%, 1/8 W	6250-2665	75042	CEA, 66.5 kΩ, ±1%	5905-726-5323
R72	Pot., Wirewound	6051-3209	80294	3005P-1-000	
R73	Comp., 1 MΩ, ±5%, 1/8 W	6098-5105	01121	BB, 1 MΩ, ±5%	
R74	Pot., Wirewound	6051-3209	80294	3005P-1-000	
R75	Film, 100 kΩ, ±1%, 1/8W	6250-3100	75042	CEA, 100 kΩ, ±1%	5905-577-6743
R76	Comp., 330 kΩ, ±5%, 1/8 W	6098-4335	01121	BB, 330 kΩ, ±5%	
R77	Film, 100 kΩ, ±1%, 1/8 W	6250-3100	75042	CEA, 100 kΩ, ±1%	5905-577-6743
R78	Comp., 1 MΩ, ±5%, 1/8 W	6098-5105	01121	BB, 1 MΩ, ±5%	
R79	Film, 10 kΩ, ±1%, 1/8 W	6250-2100	75042	CEA, 10 kΩ, ±1%	5905-882-4847
R80	Film, 11.3 kΩ, ±1%, 1/8 W	6250-2113	75042	CEA, 11.3 kΩ, ±1%	
R81	Film, 47.5 kΩ, ±1%, 1/8 W	6250-2475	75042	CEA, 47.5 kΩ, ±1%	
R82	Comp., 10 MΩ, ±5%, 1/4 W	6099-6105	75042	BTS, 10 MΩ, ±5%	

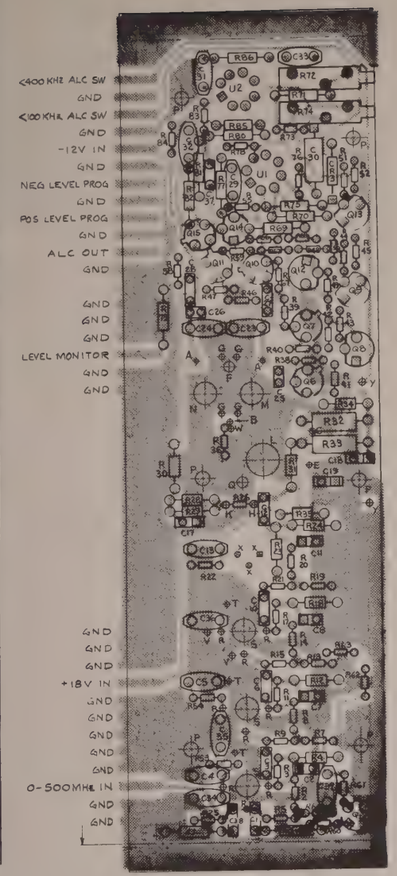
ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.
	RESISTORS (Cont)			
R83	Comp., 3 MΩ, ±5%, 1/8 W	6098-5305	01121	BB, 1 MΩ, ±5%
R84	Comp., 3.6 kΩ, ±5%, 1/8 W	6098-2365	01121	BB, 3.6 kΩ, ±5%
R85	Film, 11.3 kΩ, ±1%, 1/8 W	6250-2113	75042	CEA, 11.3 kΩ, ±1%
R86	Film, 47.5 kΩ, ±1%, 1/8 W	6250-2475	75042	CEA, 47.5 kΩ, ±1%
R90	Comp., 33 Ω, ±5%, 1/8 W	6098-0335	01121	BB, 33 Ω, ±5%
R91	Comp., 360 Ω, ±5%, 1/8 W	6098-1365	01121	BB, 360 Ω, ±5%
R92	Comp., 2.7 Ω, ±5%, 1/4 W	6099-9275		
	TRANSISTORS			
Q1 thru Q3	Type A485	8210-1194	03715	A485
Q4	Type 5109	8210-1198	79089	5109
Q5	Type 2SC1251	8210-1258	04864	2SC1251
Q6 and Q7	Type 2N4861	8210-1221	96214	2N4861
Q8	Type 2N4123	8210-1123	04713	2N4123
Q9	Type 2N4125	8210-1125	04713	2N4125
Q10 and Q11	Type 2N4861	8210-1221	96214	2N4861
Q12	Type 2N4123	8210-1123	04713	2N4123
Q13	Type 2N4125	8210-1125	04713	2N4125
Q14	Type 2N4123	8210-1123	04713	2N4123
Q15	Type 2N4861	8210-1221	96214	2N4861
Q16	Type 2N4123	8210-1123	04713	2N4123

ELECTRICAL PARTS LIST

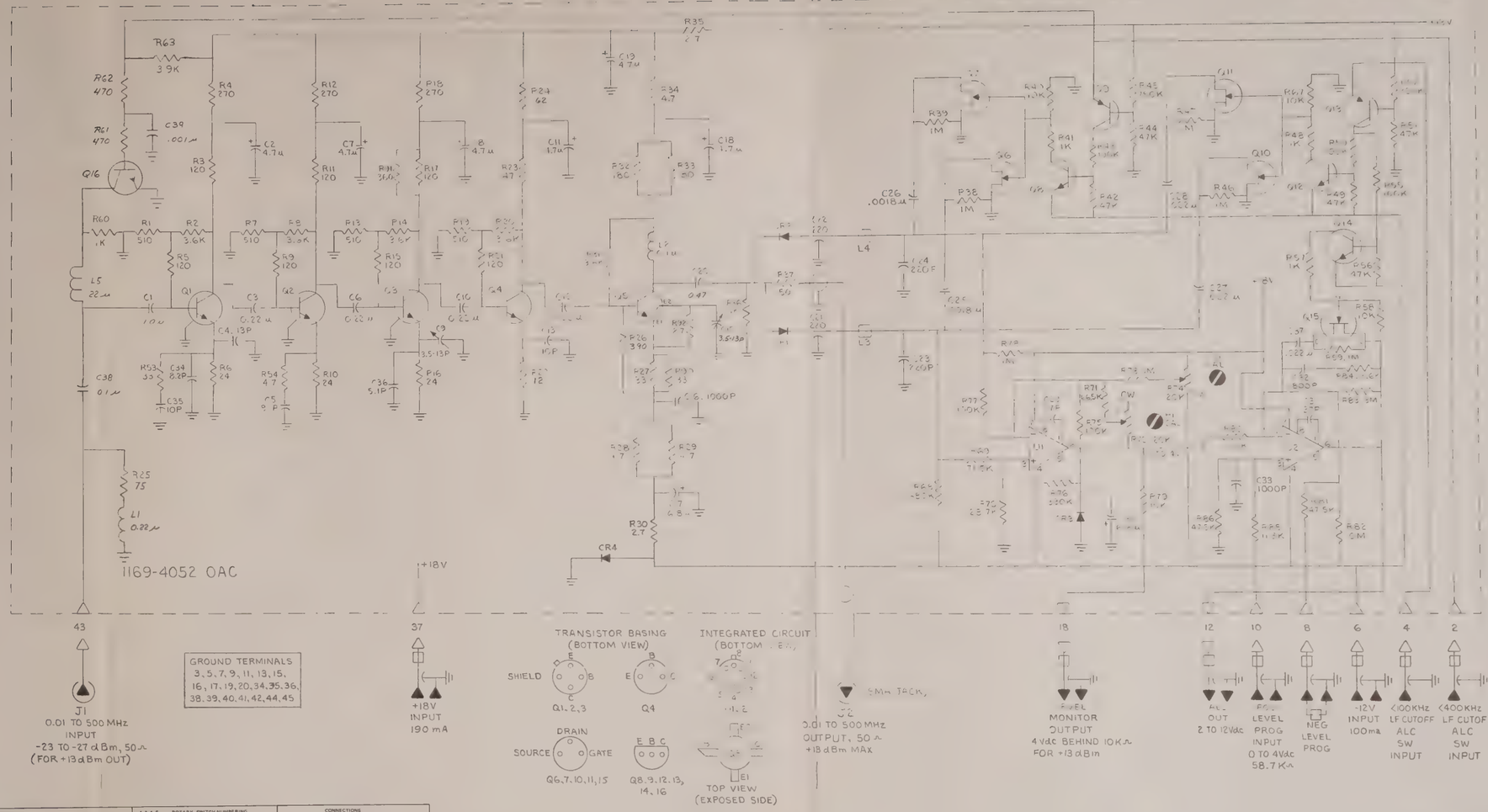
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.
	1169-2082 ENCLOSURE BASE			
	CAPACITORS			
C1 thru C8 and C9 and C10	Capacitor	1165-8770	24655	1165-8770
	Ceramic 2.2 µF ±20%, 50 V	4400-2080	72982	8141 2.2 µF ±20%
	CONNECTORS			
J1	RF Insert	1165-6020	24655	1165-6020
	INDUCTORS			
L1 thru L8	Toroid Core	5000-1267	24655	5000-1267
L9	Ferrite Bead	5000-1250	24655	5000-1250
	SOCKETS			
501 and 502 and 503 thru 505	Contact Strip	1165-1831	24655	1165-1831
	Contact Strip	1165-1813	24655	1165-1813





Etched-Circuit Diagram, Output Amplifier Board — OAC (P/N 1169-4052)

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.



RESISTANCE IS IN OHMS K = 10^3 M = 10^6
CAPACITANCE IS IN FARADS, μ = 10^{-6} P = 10^{-12}
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
R = RESISTOR C = CAPACITOR L = INDUCTOR P = PANEL CONTROL
Ø = SCREWDRIVER ADJUSTMENT WT = WIRE TIE TP = TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER, CR1, R-R1, ETC.

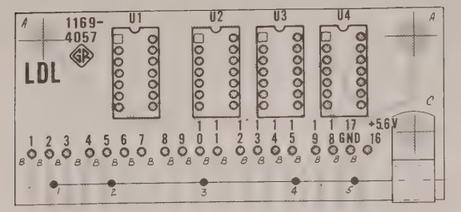
4 B A F ROTARY SWITCH NUMBERING
WAFER SURFACE FRONT REAR
CONTACTS FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS S1.
SECTION SECTION NEAREST PANEL IS 1
ROTORS SHOWN CCW

CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY

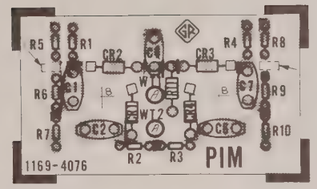
Figure 6-18. Output amplifier OAC. (P/N 1169-4052)

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
	1169-4057 LEVEL DETECTOR LOGIC BOARD (LDL)				
	INTEGRATED CIRCUITS:				
U1 and U2	Digital, Type SN74L30N	5431-8330	96214	SN74L30N	
U3 and U4	Digital, Type SN74L00N	5431-8300	96214	SN74L00N	
	1169-4076 PIN MODULATOR BOARD PIM				
	RESISTORS				
R1	Comp., 3.3 kΩ, ±5%, 1/8 W	6098-2335	01121	BB, 3.3 kΩ, ±5%	
R2 and R3	Comp., 10 kΩ, ±5%, 1/8 W	6098-3105	01121	BB, 10 kΩ, ±5%	
R4	Comp., 3.3 kΩ, ±5%, 1/8 W	6098-2335	01121	BB, 3.3 kΩ, ±5%	
R5	Comp., 430 Ω, ±5%, 1/8 W	6098-1435	01121	BB, 430 Ω, ±5%	
R6	Comp., 12 Ω, ±5%, 1/8 W	6098-0125	01121	BB, 12 Ω, ±5%	
R7 and R8	Comp., 430 Ω, ±5%, 1/8 W	6098-1435	01121	BB, 430 Ω, ±5%	
R9	Comp., 12 Ω, ±5%, 1/8 W	6098-0125	01121	BB, 12 Ω, ±5%	
R10	Comp., 430 Ω, ±5%, 1/8 W	6098-1435	01121	BB, 430 Ω, ±5%	
R11	Comp., 1.3 kΩ, ±5%, 1/4 W	6099-2135	75042	BTS, 1.3 kΩ, ±5%	5905-686-3119
	CAPACITORS				
C1 and C2	Ceramic, 1000 pF, ±10%, 500 V	4405-2108	72982	801, .001 pF, ±10%	5910-914-0087
C4	Trimmer Ceramic, 2-8 pF	4910-1202	72982	538-011, 2-8 pF	
C6 and C7	Ceramic, 1000 pF ±10% 500 V	4405-2108	72982	801, .001 pF ±10%	5910-914-0087
	DIODES				
CR1 thru CR4		6084-1037	12067	5082-3080	



Etched-circuit diagram — Level Det. Logic Board (P/N 1169-4057).



Etched-circuit diagram — Pin Modulator Board (P/N 1169-4076).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

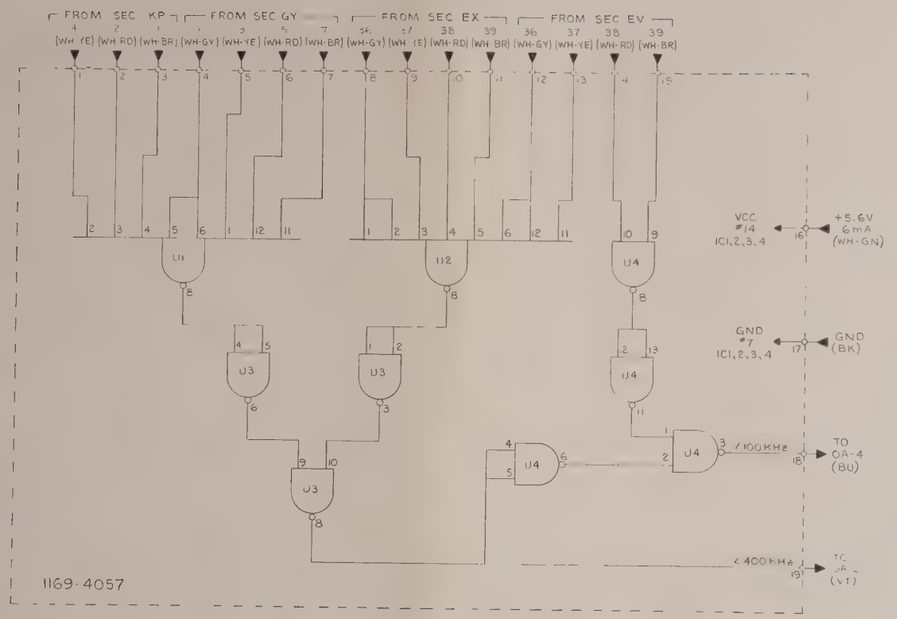


Figure 6-19. Part 1 — Level-detector logic LDL
(P/N 1169-4057)

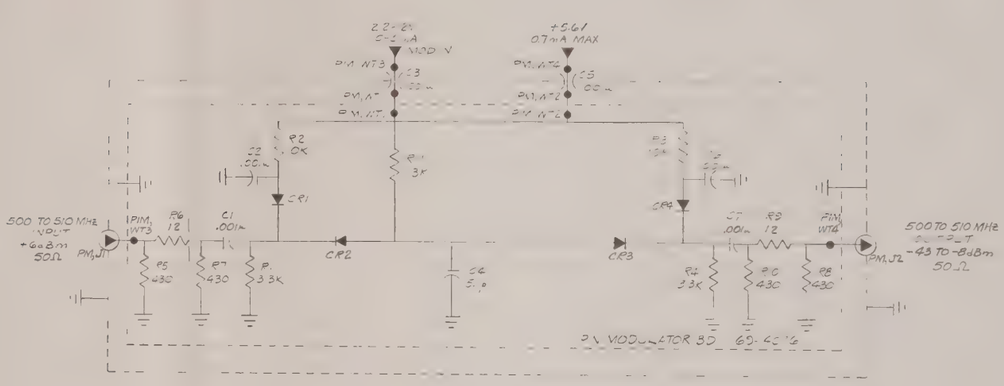


Figure 6-19. Part 2 — Pin modulator.
(P/N 1169-4076)

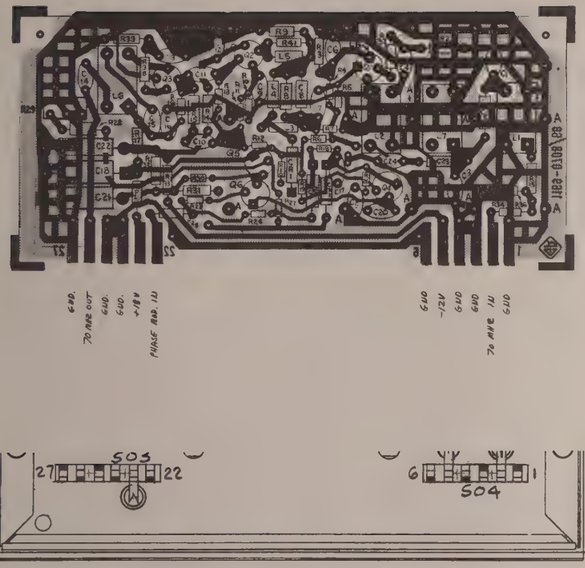
ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4008 70 MHz PHASE MODULATOR ASM (PC)					
CAPACITORS					
C1	Cer., 24 pF ±5% 100 V	4411-2006	72982	831, 24 pF ±5%	
C2	Cer., .82 pF ±5%	4400-1240	78488	GA, 82 pF ±5%	
C3	Cer., .24 pF ±5% 100 V	4411-2006	72982	831, 24 pF ±5%	
C4	Cer., .001 uF ±10% 100 V	4404-2108	72982	831, .001 uF ±5%	
C5	Cer., .01 uF +80-20% 100 V	4401-3100	80131	CC61, .01 uF +80-20%	5910-974-5697
C6	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C7	Cer., 100 pF ±5% 100 V	4404-1105	72982	831, 100 pF ±5%	
C8	Cer., 3.6 pF ±5% 500 V	4400-0500	78488	GA, 3.6 pF ±5%	
C9	Cer., .001 uF ±10% 100 V	4404-2108	72982	831, .001 uF ±5%	
C10	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C11	Cer., 47 pF ±5% 500 V	4404-0475	72982	831, 47 pF ±5%	
C12 thru C14	Cer., 470 pF ±10% 500 V	4404-1478	72982	831, 470 pF ±10%	
C15	Cer., 24 pF ±5% 100 V	4411-2006	56289	150D156X0020B2	5910-855-6335
C16	Cer., .01 uF +80-20% 100 V	4401-3100	80131	CC61, .01 uF +80-20%	5910-974-5697
C17	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C18	Tant., 15 uF ±20% 20 V	4450-5200	56289	150D156X0020B2	5910-855-6335
C20	Cer., 24 pF ±5% 100 V	4411-2006	72982	831, 24 pF ±5%	
C21	Tant., 18 uF ±20% 15 V	4450-5230	56289	150D186X001B2	
C22	Tant., 22 uF ±20% 15 V	4450-5300	56289	150D226X0015B2	5910-752-4270
C23	Cer., .82 pF ±5% 500 V	4400-1240	78488	GA, 82 pF ±5%	
C24	Cer., 24 pF ±5% 100 V	4411-2006	72982	831, 24 pF ±5%	
DIODES					
CR1 and CR2	Type 1N5148	6084-1016	00434	1N5148	
CR3	Type 1N752A	6083-1004	07910	1N752A	
INDUCTORS					
L1	Asm (BR)	1165-2200	24655	1165-2200	
L2	Asm (RD)	1165-2205	24655	1165-2205	
L3 and L4	Molded, .68 uH ±10%	4300-7522	79800	.68 uH ±10%	
L5	Molded, .82 uH ±10%	4300-7524	99800	.82 uH ±10%	
L6	Asm (OR)	1165-2210	24655	1165-2210	
L7	Asm (RD)	1165-2205	24655	1165-2205	
L8	Ferrite Bead	5000-1250	24655	5000-1250	
RESISTORS					
R2	Comp., 680 ohms, ±5% 1/4 W	6099-1685	01121	RCR07G-681J	
R3	Comp., 8.2 kilohms, ±5% 1/4 W	6099-2825	01121	RCR07G-822J	
R4	Comp., 18 kilohms, ±5% 1/8 W	6098-3185	01121	RCR05G-183J	
R5	Comp., 820 ohms, ±5% 1/8 W	6098-1825	01121	RCR05G-821J	
R6	Comp., 47 ohms, ±5% 1/8 W	6098-0475	01121	RCR05G-470J	
R7	Comp., 200 ohms, ±5% 1/8 W	6098-1205	01121	RCR05G-201J	
R8	Comp., 330 ohms, ±5% 1/4 W	6099-1335	01121	RCR07G-331J	5905-686-3369
R9	Comp., 60 ohms, ±5% 1/4 W	6099-1165	01121	RCR07G-161J	
R10	Comp., 39 kilohms, ±5% 1/8 W	6098-3395	01121	RCR05G-393J	

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
RESISTORS (cont)					
R11	Comp., 130 kilohms, ±5% 1/8 W	6098-4135	01121	RCR05G-134J	
R12	Comp., 47 ohms, ±5% 1/8 W	6098-0475	01121	RCR05G-470J	
R13	Comp., 1 kilohm, ±5% 1/8 W	6098-2105	01121	RCR05G-102J	
R14	Comp., 1.8 kilohms, ±5% 1/8 W	6099-2185	01121	RCR07G-182J	5905-688-3738
R15	Comp., 4.7 kilohms, ±5% 1/4 W	6099-2475	01121	RCR07G-472J	5905-686-9992
R16	Comp., 12 kilohms, ±5% 1/8 W	6098-3125	01121	RCR05G-123J	
R17	Comp., 47 ohms, ±5% 1/4 W	6099-0475	01121	RCR07G-470J	
R18	Comp., 510 ohms, ±5% 1/4 W	6098-1515	01121	RCR05G-511J	5905-801-8272
R19	Comp., 110 ohms, ±5% 1/8 W	6098-1115	01121	RCR05G-111J	
R20	Comp., 1.2 kilohms, ±5% 1/8 W	6098-2125	01121	RCR05G-122J	
R21	Comp., 33 ohms, ±5% 1/4 W	6099-0335	01121	RCR07G-330J	
R23	Comp., 100 ohms, ±5% 1/8 W	6098-1105	01121	RCR05G-101J	
R24	Comp., 1.5 kilohms, ±5% 1/8 W	6098-2155	01121	RCR05G-152J	
R25	Comp., 6.2 kilohms, ±5% 1/4 W	6099-2625	01121	RCR07G-622J	5905-682-4100
R26	Comp., 100 ohms, ±5% 1/8 W	6098-1105	01121	RCR05G-101J	
R27	Comp., 1.1 kilohms, ±5% 1/8 W	6098-2115	01121	RCR05G-115J	
R28	Comp., 100 ohms, ±5% 1/4 W	6099-1105	01121	RCR07G-101J	
R29	Pot. cermet, 200 ohms, ±20%	6049-0312	24655	6049-0312	
R30	Comp., 2.4 kilohms, ±5% 1/8 W	6098-2245	01121	RCR05G-242J	
R31	Comp., 620 ohms, ±5% 1/4 W	6099-1625	01121	RCR07G-621J	5905-801-8272
R32	Comp., 33 ohms, ±5% 1/4 W	6099-0335	01121	RCR07G-330J	
R33	Comp., 22 ohms, ±5% 1/4 W	6099-0225	01121	RCR07G-220J	5905-755-8389
R34	Comp., 43 ohms, ±5% 1/4 W	6099-0435	01121	RCR07G-430J	
R35	Comp., 2.7 ohms, ±5% 1/4 W	6099-9275	01121	RCR07G-2R7J	
R36	Comp., 82 ohms, ±5% 1/4 W	6099-0825	01121	RCR07G-820J	
R37	Comp., 22 ohms, ±5% 1/4 W	6099-0225	01121	RCR07G-220J	5905-755-8389
R38	Comp., 15 ohms, ±5% 1/4 W	6099-0155	01121	RCR07G-150J	
R39	Comp., 470 ohms, ±5% 1/4 W	6099-1475	01121	RCR07G-471J	5905-683-2242
R41	Comp., 100 kilohms, ±5% 1/4 W	6099-4105	01121	RCR07G-104J	5905-686-3129
TRANSISTORS					
Q1	Type 2N5179	8210-1195	79089	2N5179	
Q2	Type 3N159	8210-1193	79089	3N159	
Q3	Type 2N5179	8210-1195	79089	2N5179	
Q4	Type 2N3906	8210-1112	04713	2N3906	
Q5 and Q6	Type 2N3903	8210-1132	04713	2N3903	
1169-2078 ENCLOSURE BASE (PM)					
CAPACITORS					
P-C1 and P-C2	Cer., 1000 pF +100-0% 500 V	4400-2200	01121	FA5C, 1000 pF +100-0%	
P-C3	Cer., 12 pF ±5% 100 V	4411-0125	72982	801, 12 pF ±5%	
CONNECTORS					
P-J1 thru P-J5	RF Insert	1165-6020	24655	1165-6020	
S03	Contact strip	1165-1811	24655	1165-1811	
S04	Contact strip	1165-1820	24655	1165-1820	

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.



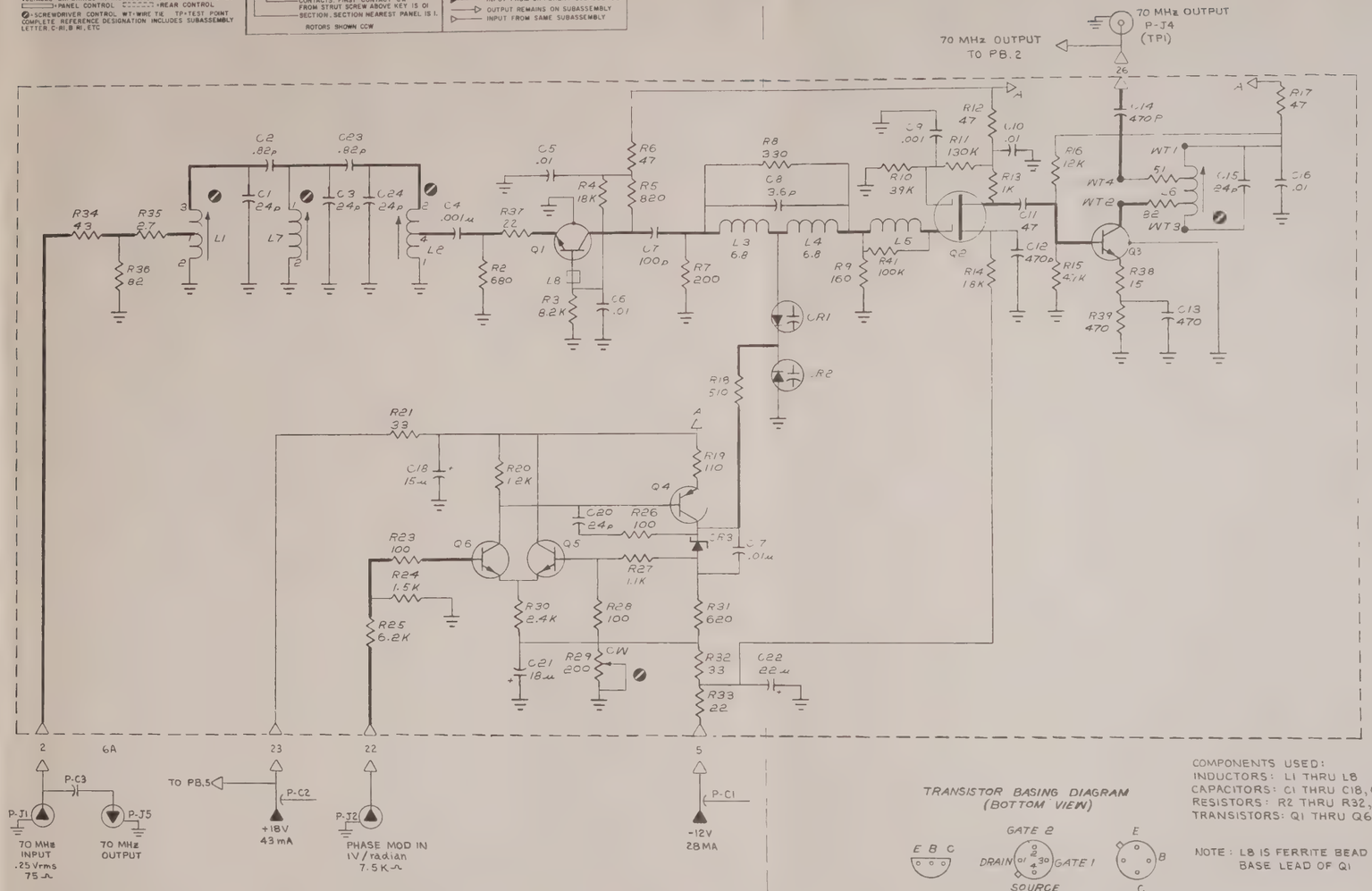
Etched-circuit diagram, Phase Modulator board — PC (P/N 1169-4008).

RESISTANCE IS IN OHMS, K=10^3, M=10^6
CAPACITANCE IS IN FARADS, μ=10^{-6}, p=10^{-12}
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
PANEL CONTROL ○○○○ REAR CONTROL
⊘ SCREWDRIVER CONTROL WT WIRE TIE TP TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER C-A1, B W1, ETC

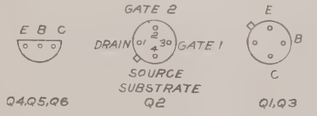
404F SWITCH NUMBERING
FRONT, REAR
CONTACTS FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS 01
SECTION, SECTION NEAREST PANEL IS 1.
ROTORS SHOWN CCW

CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY

ALL FEED-THROUGH CAPACITORS ARE GROUNDED TO ENCLOSURE AND ARE 1000 pF



TRANSISTOR BASING DIAGRAM (BOTTOM VIEW)



COMPONENTS USED:
INDUCTORS: L1 THRU L8
CAPACITORS: C1 THRU C18, C20, C21, C22
RESISTORS: R2 THRU R32, R34 THRU R39, R41
TRANSISTORS: Q1 THRU Q6

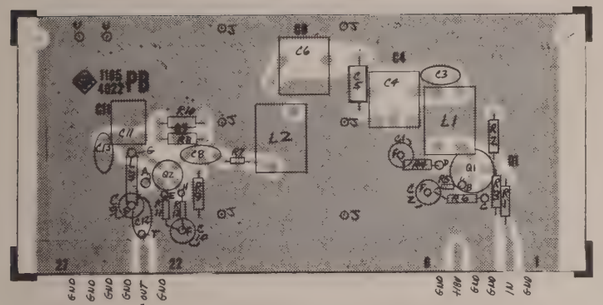
NOTE: L8 IS FERRITE BEAD ON BASE LEAD OF Q1

Figure 6-20. Phase modulator — PC (P/N 1169-4008).

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1165-4022 420 MHz CIRCUIT ASM. (PB) (PM – 420)					
CAPACITORS					
C1 and C2	Cer., .001 uF +100-0% 300 V	4400-5700	00656	BC-C1-2-NM	
C3	Cer., 3.0 pF ±5% 500 V N30	4411-0035	72982	831, 3.0 pF ±5%	
C4	Air Dielectric, 1.4-9.2 pF ±10%	4380-3800	74970	189-503-105	
C5	Cer., 0.47 pF ±10% 500 V	4400-1200	78488	GA, .47 pF ±10%	
C6	Air Dielectric, 1.4-9 pF ±10%	4380-3800	74970	189-503-105	
C8	Cer., 22 pF ±10% 500 V	4404-0228	72982	831, 22 pF ±10%	
C9 and C10	Cer., .001 uF +100-0% 300 V	4400-5700	00656	BC-C1-2-NM	
C11	Trimmer, 1.0-4.5 pF	4910-1102	73899	VC10GWV	
C12	Cer., 470 pF ±5% 500 V	4404-1475	72982	831, 470 pF ±5%	
C13	Cer., 3.0 pF ±5% 500 V N30	4411-0035	72982	831, 3.0 pF ±5%	
INDUCTORS					
L1	Asm (YE)	1165-2215	24655	1165-2215	
L2	Asm (GN)	1165-2225	24655	1165-2225	
L3	Asm (OR)	1165-8185	24655	1165-8185	
RESISTORS					
R1	Comp., 4.7 ohms, ±5% 1/4 W	6099-9475	01121	RCR07G-4R7J	
R2	Comp., 27 kilohms, ±5% 1/4 W	6099-3275	01121	RCR07G-273J	5905-683-3838
R3	Comp., 1 kilohm, ±5% 1/4 W	6099-2105	01121	RCR07G-102J	5905-681-6462
R4	Comp., 47 ohms, ±5% 1/4 W	6099-0475	01121	RCR07G-470J	
R5	Comp., 10 ohms, ±5% 1/8 W	6098-0105	01121	RCR05G-100J	
R6	Comp., 180 ohms, ±5% 1/4 W	6099-1185	01121	RCR07G-181J	5905-279-5476
R7	Comp., 15 ohms, ±5% 1/8 W	6098-0155	01121	RCR05G-150J	
R8	Comp., 30 kilohms, ±5% 1/4 W	6099-3305	01121	RCR07G-303J	5905-803-2908
R9	Comp., 3.9 kilohms, ±5% 1/4 W	6099-2395	01121	RCR07G-392J	
R10	Comp., 47 ohms, ±5% 1/4 W	6099-0475	01121	RCR07G-470J	
R11	Comp., 220 ohms, ±5% 1/4 W	6099-1225	01121	RCR07G-221J	5905-683-2240
R12	Comp., 10 ohms, ±5% 1/8 W	6098-0105	01121	RCR05G-100J	
TRANSISTORS					
Q1 and Q2	Type A485	8210-1194	73445	A485	
1169-2078 ENCLOSURE BASE (PM)					
CAPACITORS					
P-C2	Cer., 1000 pF +100-0% 500 V	4400-2200	01121	FA5C, 1000 pF +100-0%	
CONNECTORS					
P-J3	RF Insert	1165-6020	24655	1165-6020	
S01	Contact strip	1165-1820	24655	1165-1820	
S02	Contact strip	1165-1833	24655	1165-1833	

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is not shown. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.



Etched-circuit diagram, Phase Modulator Multiplier board — PB (P/N 1165-4022).

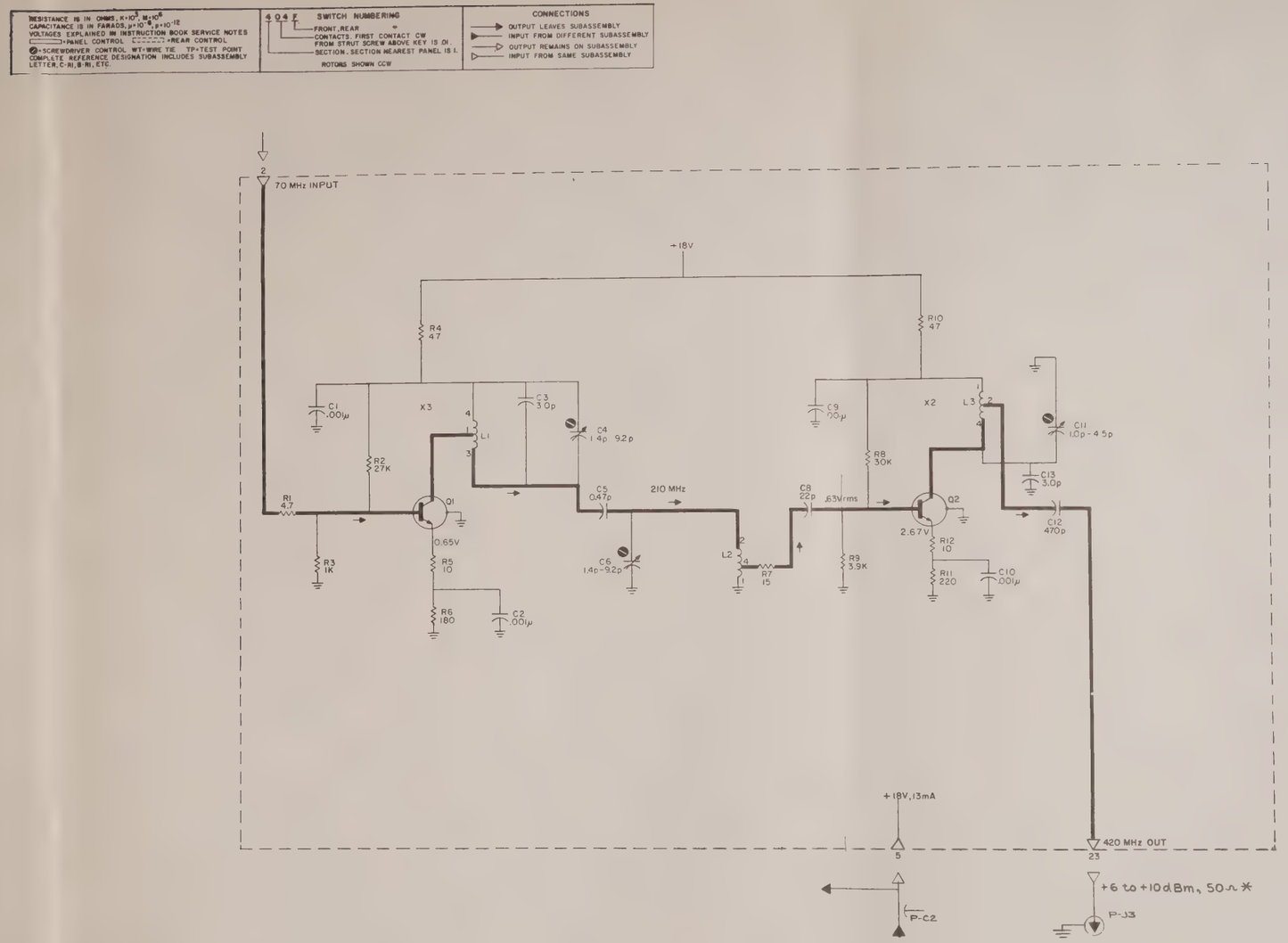


Figure 6-21. Phase modulator multiplier — PB (P/N 1165-40

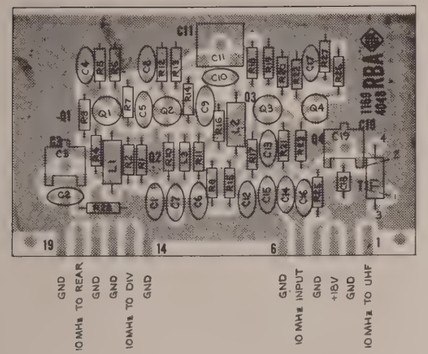
ELECTRICAL PARTS LIST

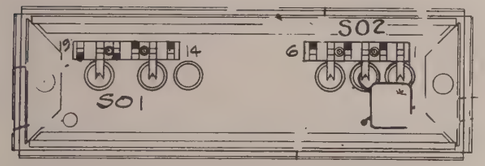
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4048 REFERENCE BUFFER BOARD (RBA)					
CAPACITORS					
C1	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C2	Cer., 15 pF ±5% 500 V N030	4411-0155	72982	801, 15 pF ±5%	
C3	Trimmer cer., 7-25 pF	4910-2032	72982	538-006, 7 to 25 pF	5910-998-1621
C4 thru C9	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C10	Cer., 20 pF ±5% 500 V N030	4411-0205	72982	801, 20 pF ±5%	
C11	Trimmer cer., 7-25 pF	4910-2032	72982	538-006, 7 to 25 pF	5910-998-1621
C12 thru C17	Cer., .01 uF +80-20% 100 V	4401-3100	72982	801, .01 uF +80-20%	5910-974-5697
C18	Cer., 62 pF ±5% 100 V N030	4411-2002	09392	855, 62 pF ±5%	
C19	Trimmer cer., 7-25 pF	4910-2032	72982	538-006, 7 to 25 pF	5910-998-1621
INDUCTORS					
L1	Molded, 8.2 uH ±10%	4300-2100	99800	1537-8.2 uH ±10%	5905-823-3168
L2	Molded, 6.8 uH ±10%	4300-1900	99800	1537-6.8 uH ±10%	
L3	Molded, 8.2 uH ±10%	4300-7558	99800	1537-8.2 uH ±10%	
RESISTORS					
R1	Comp., 100 ohms, ±5% 1/4 W	6099-1105	01121	RCR07G-101J	
R2	Comp., 3.6 kilohms, ±5% 1/4 W	6099-2365	01121	RCR07G-362J	5905-577-0627
R3	Comp., 15 kilohms, ±5% 1/4 W	6099-3155	01121	RCR07G-153J	5905-681-8818
R4	Comp., 47 ohms, ±5% 1/4 W	6099-0475	01121	RCR07G-470J	
R5	Comp., 2 kilohms, ±5% 1/4 W	6099-2205	01121	RCR07G-202J	5905-686-3370
R6	Comp., 180 ohms, ±5% 1/4 W	6099-1185	01121	RCR07G-181J	5905-682-4107
R7 and R8	Comp., 100 ohms, ±5% 1/4 W	6099-1105	01121	RCR07G-101J	
R10	Comp., 100 ohms, ±5% 1/4 W	6099-1105	01121	RCR07G-101J	
R11 and R12	Comp., 10 kilohms, ±5% 1/4 W	6099-3105	01121	RCR07G-103J	5905-683-2238
R13	Comp., 1.2 kilohms, ±5% 1/4 W	6099-2125	01121	RCR07G-122J	
R14	Comp., 100 ohms, ±5% 1/4 W	6099-1105	01121	RCR07G-101J	
R15	Comp., 620 ohms, ±5% 1/4 W	6099-1625	01121	RCR07G-621J	5905-801-6998
R16	Comp., 3.3 kilohms, ±5% 1/4 W	6099-2335	01121	RCR07G-332J	5905-681-9969
R17	Comp., 15 kilohms, ±5% 1/4 W	6099-3155	01121	RCR07G-153J	5905-681-8818
R18	Comp., 47 ohms, ±5% 1/4 W	6099-0475	01121	RCR07G-470J	
R19	Comp., 3 kilohms, ±5% 1/4 W	6099-2305	01121	RCR07G-302J	5905-682-4097
R20	Comp., 390 ohms, ±5% 1/4 W	6099-1395	01121	RCR07G-391J	
R21	Comp., 130 ohms, ±5% 1/4 W	6099-1135	01121	RCR07G-131J	5905-807-0269
R22	Comp., 3 kilohms, ±5% 1/4 W	6099-2305	01121	RCR07G-302J	5905-682-4097
R23	Comp., 15 kilohms, ±5% 1/4 W	6099-3155	01121	RCR07G-153J	5905-681-8818
R25	Comp., 470 ohms, ±5% 1/4 W	6099-1475	01121	RCR07G-471J	5905-683-2242
R26	Comp., 43 ohms, ±5% 1/4 W	6099-0435	01121	RCR07G-430J	
R27	Comp., 180 ohms, ±5% 1/4 W	6099-1185	01121	RCR07G-181J	5905-682-4107
R28	Comp., 100 ohms, ±5% 1/4 W	6099-1105	01121	RCR07G-101J	
TRANSFORMERS					
T1	Wound	1165-2039	24655	1165-2039	
TRANSISTORS					
Q1	Type 2N3903	8210-1132	04713	2N3903	
Q2 and Q3	Type 2N5179	8210-1195	79089	2N5179	
Q4	Type 2N3903	8210-1132	04713	2N3903	

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-2047 ENCLOSURE BASE (RM)					
CAPACITORS					
RM-C1	Cer., 1000 pF +100-0% 500 V	4400-2200	01121	FA5C, 1000 pF +100-0%	
RM-C2	Cer., 2.2 uF ±20% 50 V	4400-2080	72982	8141, 2.2 uF ±20%	
CONNECTORS					
RM-J1 thru RM-J5	RF Insert	1165-6020	24655	1165-6020	
S01	Contact strip asm.	1165-1820	24655	1165-1820	
S02	Contact strip asm.	1165-1831	24655	1165-1831	
INDUCTOR					
RM-L1	Toroid Core	5000-1267	02114	1041CT060-3E2A	

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is not shown. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.



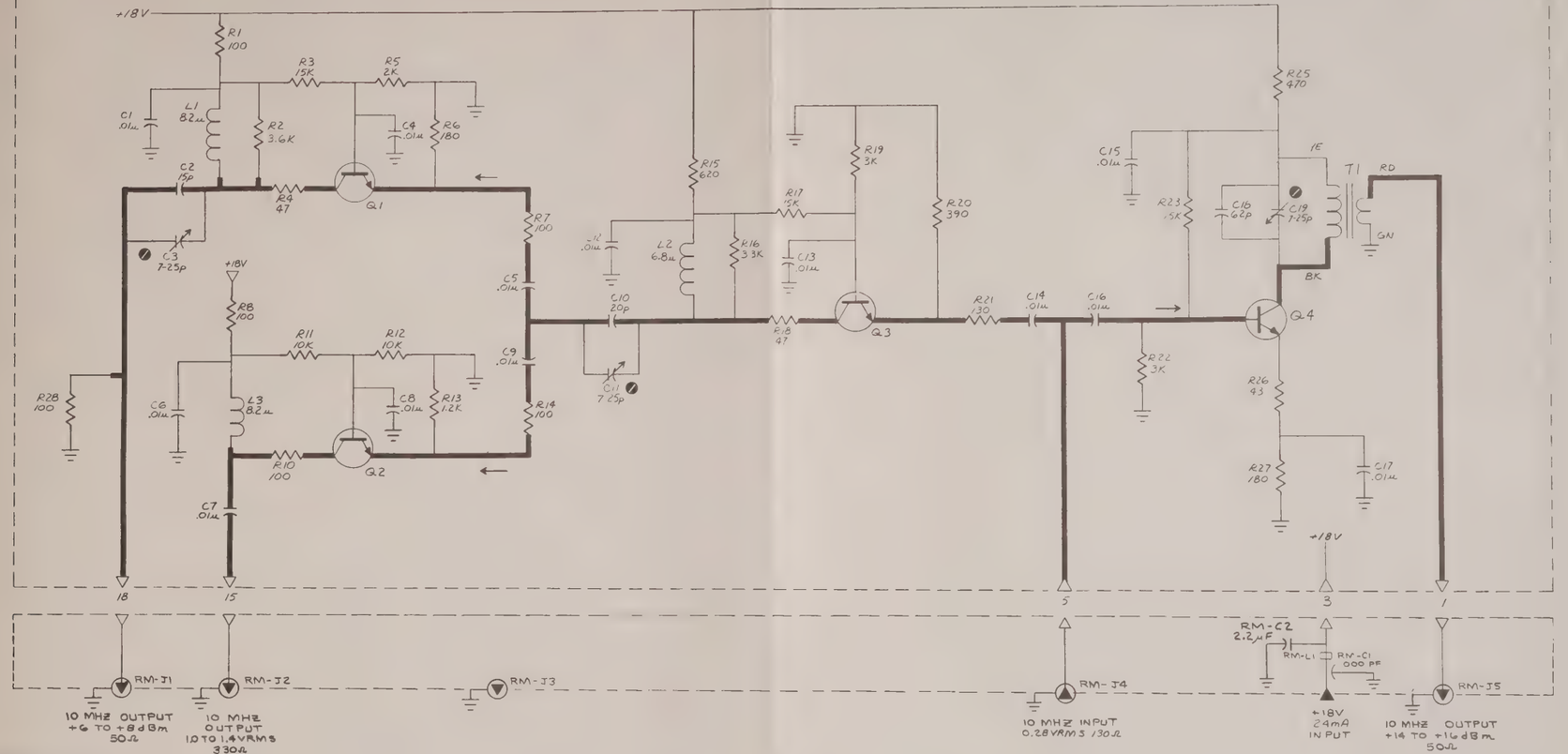


Etched-circuit diagram, Reference buffer board — RBA (P/N 1169-4048).

RESISTANCE IS IN OHMS, K=10^3, M=10^6
CAPACITANCE IS IN FARADS, μ=10^{-6}, p=10^{-12}
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
——— = PANEL CONTROL - - - - - = REAR CONTROL
⊘ = SCREWDRIVER CONTROL, WT = WIRE TIE, TP = TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER, C-R1, B-R7, ETC

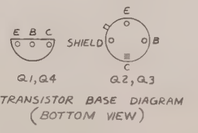
4 0 4 F — SWITCH NUMBERING
4 — FRONT, REAR
0 — CONTACTS. FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS .01
4 — SECTION. SECTION NEAREST PANEL IS 1.
F — ROTORS SHOWN CCW

CONNECTIONS
→ OUTPUT LEAVES SUBASSEMBLY
▶ INPUT FROM DIFFERENT SUBASSEMBLY
▷ OUTPUT REMAINS ON SUBASSEMBLY
▷ INPUT FROM SAME SUBASSEMBLY



COMPONENTS USED:
INDUCTORS: L1,2,3
CAPACITORS: C1 THRU C19
RESISTORS: R1 THRU R8, R10 THRU R23, R25 THRU R28
TRANSISTORS: Q1,2,3,4
TRANSFORMER: T1

GROUND CONTACT PINS:
2,4,6,14,16,17,19



TRANSISTOR BASE DIAGRAM (BOTTOM VIEW)

Figure 6-22. Reference Buffer — RBA (P/N 1169-4048).

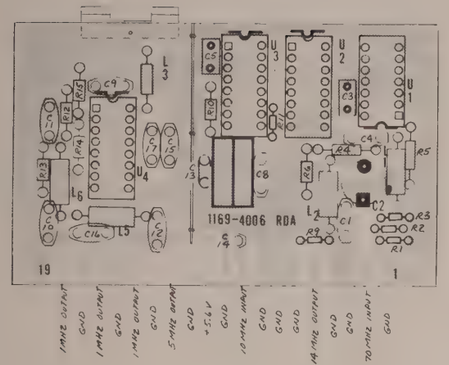
ELECTRICAL PARTS LIST

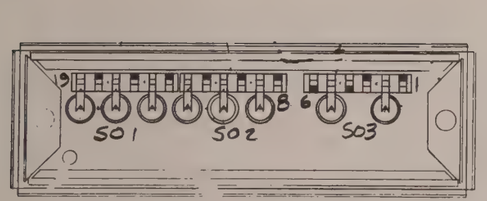
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4006 REFERENCE DIVIDER BOARD (RDA)					
CAPACITORS					
C1 thru C3	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C4	Cer., 10 pF ±5% 500 V	4411-0105	72982	831, 10 pF ±5%	
C5	Trimmer cer., 5.5-18 pF	4910-2031	72982	538-006, 5.5-18 pF	
C6	Tant., 3.3 uF ±20% 15 V	4450-4600	56289	150D335X0015A2	5910-837-9325
C7 and C8	Cer., 10 pF ±5% 500 V	4411-0105	72982	831, 10 pF ±5%	
C9	Trimmer cer., 5.5-18 pF	4910-2031	72982	538-006, 5.5-18 pF	
C10	Cer., 220 pF ±10% 500 V	4404-1228	72982	831, 220 pF ±10%	
C11 and C12	Cer., 120 pF ±5% 500 V	4404-1125	72982	831, 120 pF ±5%	
C13	Tant., 3.3 uF ±20% 15 V	4450-4600	56289	150D335X0015A2	5910-837-9325
C14 thru C17	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C18	Cer., 3.3 pF ±5% 500 V	4411-9335	72982	831, 3.3 pF ±5%	
C19	Cer., 1 uF ±20% 50 V	4400-2070	72982	8131, 1 uF ±20%	
INDUCTORS					
L1	Molded, 0.15 uH ±10%	4300-0100	99800	1537-38, 0.15 uH ±10%	
L2 and L3	Molded, 12.0 uH ±10%	4300-2300	99800	1537-38, 12 uH ±10%	5950-807-6050
INTEGRATED CIRCUITS					
U1 and U2	Type MC1032	5431-9620	04713	MC1032P	
U3	Type SN74160N	5431-8060	96214	SN74160N	
RESISTORS					
R1	Comp., 4.7 kilohms, ±5% 1/4 W	6099-2475	01121	RCR07G-472J	5905-686-9992
R2	Comp., 4.7 ohms, ±5% 1/4 W	6099-9475	01121	RCR07G-4R7J	
R3	Comp., 820 ohms, ±5% 1/4 W	6099-1825	01121	RCR07G-821J	
R4	Comp., 100 ohms, ±5% 1/4 W	6099-1105	01121	RCR07G-101J	
R5	Comp., 33 ohms, ±5% 1/4 W	6099-0335	01121	RCR07G-330J	
R6	Comp., 1.5 kilohms, ±5% 1/4 W	6099-2155	01121	RCR07G-152J	
R7	Comp., 620 ohms, ±5% 1/4 W	6099-1625	01121	RCR07G-621J	5905-801-6998
R8	Comp., 6.8 ohms, ±5% 1/4 W	6099-9685	01121	RCR07G-6R8J	
R9	Comp., 11 ohms, ±5% 1/4 W	6099-0115	01121	RCR07G-110J	
R10	Comp., 2 kilohms, ±5% 1/4 W	6099-2205	01121	RCR07G-202J	5905-686-3370
R11	Comp., 510 ohms, ±5% 1/4 W	6099-1515	01121	RCR07G-511J	5905-801-8272
R12 and R13	Comp., 820 ohms, ±5% 1/4 W	6099-1825	01121	RCR07G-821J	
TRANSFORMERS					
T1	Asm	1160-2615	24655	1160-2615	
TRANSISTORS					
Q1	Type 2N2369	8210-1052	96214	2N2369	5960-682-7755

ELECTRICAL PARTS LIST (cont)

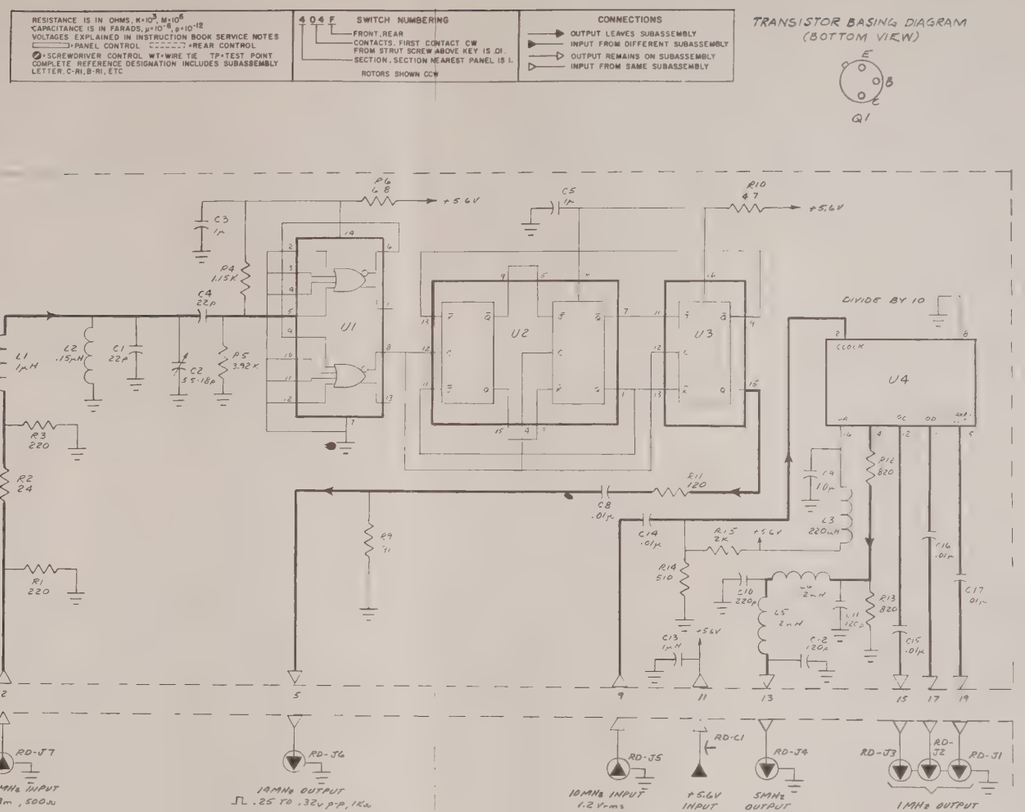
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-2007 ENCLOSURE BASE (RD)					
CAPACITORS					
RD-C1	Cer., 1000 pF +100-0% 500 V	4400-2200	01121	FA5C, 1000 pF +100-0%	
RD-C2	Cer., 2.2 uF ±20% 50 V	4400-2080	72982	8141, 2.2 uF ±20%	
CONNECTORS					
RD-J1 thru RD-J7	RF Connector	1165-6020	24655	1165-6020	
S01 and S02	Contact Strip Asm	1165-1830	24655	1165-1830	
S03	Contact Strip Asm	1165-1820	24655	1165-1820	

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.





Etched-circuit diagram, Reference Divider board – RDA (P/N 1169-4006).



ALL FEED-THROUGH CAPACITORS ARE GROUNDED TO ENCLOSURE AND ARE 1000pF

COMPONENTS USED:

CAPACITORS: C1 THRU C17
RESISTORS: R1 THRU R11
TRANSISTOR: Q1
INTEGRATED CIRCUITS: U1, U2, U3, U4
INDUCTORS: L1, L2, L3
TRANSFORMER: T1

NOTE:

U1 GND PINS: 2, 4, 8, 10, 14
U2 GND PINS: 2, 3, 4, 5, 6, 8, 10

BOARD & TRAY GND TERM'S USED
1, 3, 4, 6, 7, 8, 10, 12, 14,

Figure 6-23. Reference Divider – RDA (P/N 1169-4006

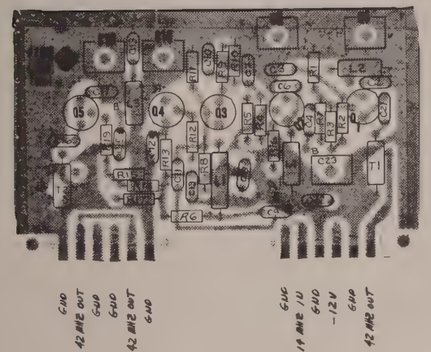
ELECTRICAL PARTS LIST

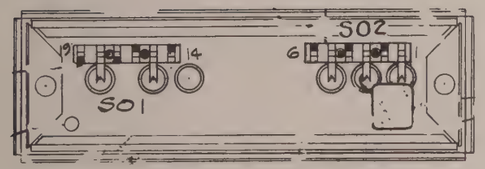
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4000 REFERENCE MULTIPLIER BOARD (RMA)					
CAPACITORS					
C1	Trimmer, cer., 5.5-18 pF	4910-2031	72982	538-006, 5.5 to 18 pF	
C2	Cer., 47 pF ±5% 100 V N080	4412-0475	05286	47 pF ±5%	
C3	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C4	Cer., 1000 pF ±10% 500 V	4405-2108	72982	801, .001 uF ±10%	5910-914-0087
C5	Trimmer, cer., 5.5-18 pF	4910-2031	72982	538-006, 5.5 to 18 pF	
C6	Cer., 47 pF ±5% 100 V N080	4412-0475	05286	47 pF ±5%	
C7	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C8	Mica, 261 pF ±1% 500 V	4710-0441	72136	DM-15, 261 pF ±10%	
C9 thru C12	Cer., .01 uF +80-20% 100 V	4401-3100	80131	CC61, .01 uF +80-20%	5910-974-5697
C13	Cer., 47 pF ±5% 100 V N080	4412-0475	05286	47 pF ±5%	
C14	Trimmer, cer., 5.5-18 pF	4910-2031	72982	538-006, 5.5 to 18 pF	
C15	Cer., 1000 pF ±10% 500 V	4405-2108	72982	801, .001 uF ±10%	5910-914-0087
C16	Cer., .01 uF +80-20% 100 V	4401-3100	80131	CC61, .01 uF +80-20%	5910-974-5697
C17	Cer., 47 pF ±5% 100 V N080	4412-0475	05286	47 pF ±5%	
C18	Trimmer, cer., 5.5-18 pF	4910-2031	72982	538-006, 5.5 to 18 pF	
C19	Cer., .01 uF +80-20% 100 V	4401-3100	80131	CC61, .01 uF +80-20%	5910-974-5697
C21	Cer., 2.7 pF ±5% 500 V N030	4411-9275	80131	CC60, 2.7 pF ±5%	
C22	Cer., 47 pF ±5% 100 V N080	4412-0475	05286	47 pF ±5%	
C23	Trimmer, cer., 5.5-18 pF	4910-2031	72982	538-006, 5.5 to 18 pF	
INDUCTORS					
L1	Molded, 0.47 uH ±10%	4300-7537	99800	1537, .047 uH ±2%	
L2 thru L4	Molded, 0.22 uH ±10%	4300-0205	99800	1536, .022 uH ±10%	
L5 and L6	Connector Wire, PC	5080-1260	12368	5080-1260	5940-351-1404
RESISTORS					
R1	Comp., 15 kilohms, ±5% 1/4 W	6099-3155	01121	RCR07G-153J	5905-681-8818
R2	Comp., 220 ohms, ±5% 1/4 W	6099-1225	01121	RCR07G-121J	5905-683-2240
R3	Comp., 3.3 kilohms, ±5% 1/4 W	6099-2335	01121	RCR07G-332J	5905-681-9969
R4	Comp., 680 ohms, ±5% 1/4 W	6099-1685	01121	RCR07G-681J	
R5	Comp., 100 ohms, ±5% 1/4 W	6099-1105	01121	RCR07G-101J	
R6	Comp., 47 ohms, ±5% 1/4 W	6099-0475	01121	RCR07G-470J	
R7	Comp., 10 ohms, ±5% 1/4 W	6099-0105	01121	RCR07G-100J	
R8	Comp., 22 kilohms, ±5% 1/4 W	6099-3225	01121	RCR07G-223J	5905-687-0002
R9	Comp., 100 ohms, ±5% 1/4 W	6099-1105	01121	RCR07G-101J	
R10	Comp., 390 ohms, ±5% 1/4 W	6099-1395	01121	RCR07G-391J	
R11	Comp., 3.3 kilohms, ±5% 1/4 W	6099-2335	01121	RCR07G-332J	5905-681-9969
R12	Comp., 100 ohms, ±5% 1/4 W	6099-1105	01121	RCR07G-101J	
R13	Comp., 680 ohms, ±5% 1/4 W	6099-1685	01121	RCR07G-681J	
R14	Comp., 3.3 kilohms, ±5% 1/4 W	6099-2335	01121	RCR07G-332J	5905-681-9969
R15	Comp., 15 kilohms, ±5% 1/4 W	6099-3155	01121	RCR07G-153J	5905-681-8818
R16	Comp., 47 ohms, ±5% 1/4 W	6099-0475	01121	RCR07G-470J	
R17	Comp., 390 ohms, ±5% 1/4 W	6099-1395	01121	RCR07G-391J	
R19	Comp., 10 ohms, ±5% 1/4 W	6099-0105	01121	RCR07G-100J	

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
TRANSFORMERS					
T1 and T2	R-f Asm	1169-2600	24655	1169-2600	
TRANSISTORS					
Q1 and Q2	Type 2N2369	8210-1052	96214	2N2369	5960-682-7755
Q3	Type 2N3250	8210-1089	07263	2N3250	5961-945-4108
Q4 and Q5	Type 2N2369	8210-1052	96214	2N2369	5960-682-7755
1169-2047 ENCLOSURE BASE (RM)					
CAPACITOR					
RM-C1	Cer., 1000 pF +100-0% 500 V	4400-2200	01121	FASC, 1000 pF +100-0%	
RM-C2	Cer., 2.2 uF ±20% 50 V	4400-2080	72982	8141, 2.2 uF ±20%	
INDUCTOR					
RM-L1	Toroid Core	5000-1267	02114	1041CT060-3E2A	
CONNECTORS					
RM-J1 thru RM-J5	RF Insert	1165-6020	24655	1165-6020	
S01	Contact Strip Asm	1165-1820	24655	1165-1820	
S02	Contact Strip Asm	1165-1831	24655	1165-1831	

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is not shown. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.





Etched-circuit diagram, Reference Multiplier board – RMA (P/N 1169-4000).

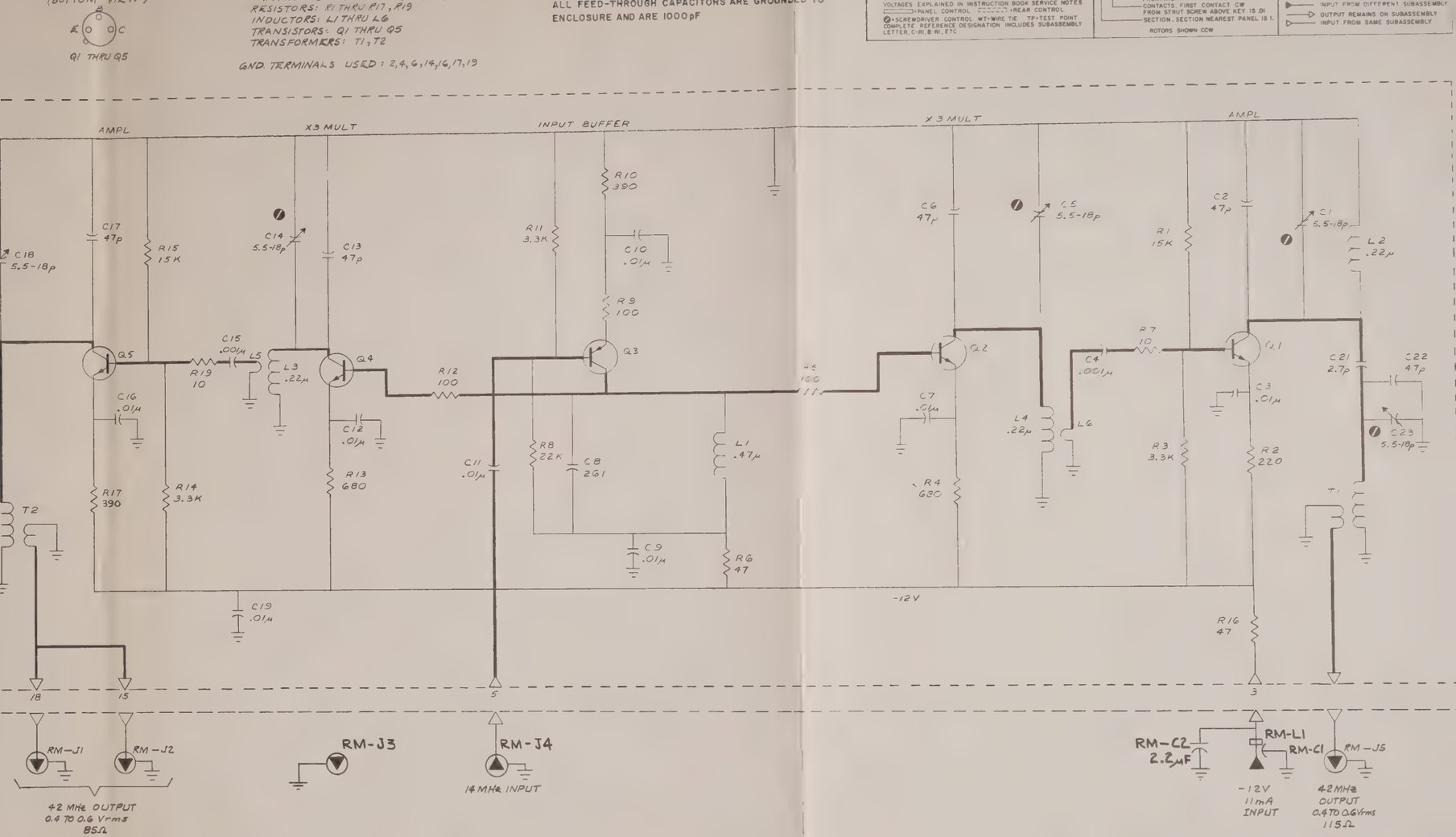


Figure 6-24. Reference Multiplier – RMA (P/N 1169-400

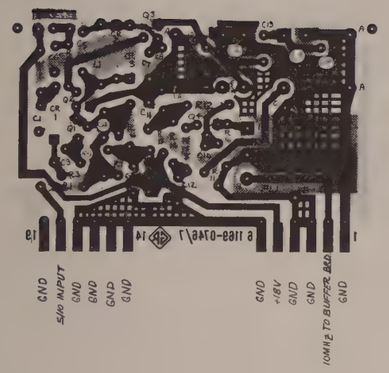
ELECTRICAL PARTS LIST

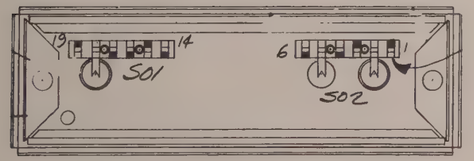
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4046 REFERENCE PROCESSOR BOARD (RPA)					
CAPACITORS					
C1 thru C4	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C5	Cer., 75 pF ±5% 500 V N030	4411-0753	72982	801, 75 pF ±5%	
C6 and C7	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C8 and C9	Mica, 270 pF ±1% 500 V	4710-0450	14655	22A, 270 pF ±1%	
C10 thru C12	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C13	Cer., 12 pF ±5% 500 V N030	4411-0125	72982	801, 12 pF ±5%	
DIODES					
CR1 thru CR3	Type 1N3604	6082-1001	24446	1N3604	
FILTERS					
FL1	Crystal, 10 MHz	5284-1000	82567	#F13138	
INDUCTORS					
L1	Molded, 3.3 uH ±5%	4300-1402	24655	4300-1402	
L2 and L3	Asm (VT)	1169-2420	24655	1169-2420	
RESISTORS					
R1	Comp., 47 ohms, ±5% 1/4 W	6099-0475	01121	RCR07G-470J	
R2	Comp., 51 kilohms, ±5% 1/4 W	6099-3515	01121	RCR07G-573J	
R3	Comp., 47 ohms, ±5% 1/4 W	6099-0475	01121	RCR07G-470J	
R4	Comp., 100 ohms, ±5% 1/4 W	6099-1105	01121	RCR07G-101J	
R5	Comp., 2.2 kilohms, ±5% 1/4 W	6099-2225	01121	RCR07G-222J	5905-723-5251
R6 and R7	Comp., 10 kilohms, ±5% 1/4 W	6099-3105	01121	RCR07G-103J	5905-683-2283
R8	Comp., 2.0 kilohms, ±5% 1/4 W	6099-2205	01121	RCR07G-202J	
R9	Pot. cermet, 5 kilohms, ±20%	6049-0316	24655	6049-0316	
R10	Comp., 1 kilohm, ±5% 1/4 W	6099-2105	01121	RCR07G-102J	5905-681-6422
R11 and R12	Comp., 10 kilohms, ±5% 1/4 W	6099-3105	01121	RCR07G-103J	5905-683-2283
R13	Comp., 100 ohms, ±5% 1/4 W	6099-1105	01121	RCR07G-101J	
R14	Comp., 1 kilohm, ±5% 1/4 W	6099-2105	01121	RCR07G-102J	5905-681-6422
R15	Comp., 200 ohms, ±5% 1/4 W	6099-1205	01121	RCR07G-201J	5905-683-2239
R16	Comp., 150 ohms, ±5% 1/4 W	6099-1155	01121	RCR07G-151J	5905-683-2243
TRANSISTORS					
Q1	Type 2N3905	8210-1114	04713	2N3905	
Q2 and Q3	Type 2N4121	8210-1151	07263	2N4121	
Q4	Type 2N3905	8210-1114	04713	2N3905	

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-2052 ENCLOSURE BASE (RP)					
CAPACITOR					
RP-C1	Cer., 1000 pF +100-0% 500 V	4400-2200	01121	FA5C, 1000 pF +100-0%	
CONNECTORS					
RP-J1 and RP-J2	RF Insert	1165-6020	24655	1165-6020	
S01	Contact Strip Asm	1165-1812	24655	1165-1812	
S02	Contact Strip Asm	1165-1820	24655	1165-1820	

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.





Etched-circuit diagram, Reference Processor board (P/N 1169-4046).

RESISTANCE IS IN OHMS, K=10^3, M=10^6
CAPACITANCE IS IN FARADS, μ=10^{-6}, p=10^{-12}
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
PANEL CONTROL, REAR CONTROL
SCREWDRIVER CONTROL, WT=WIRE TIE, TP=TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER C-R-L-B-N-ETC

4 0 4 F SWITCH NUMBERING
FRONT, REAR
CONTACTS FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS 01
SECTION, SECTION NEAREST PANEL IS 1
ROTORS SHOWN CCW

CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY

ALL FEED-THROUGH CAPACITORS ARE GROUNDED TO ENCLOSURE AND ARE 1000 pF

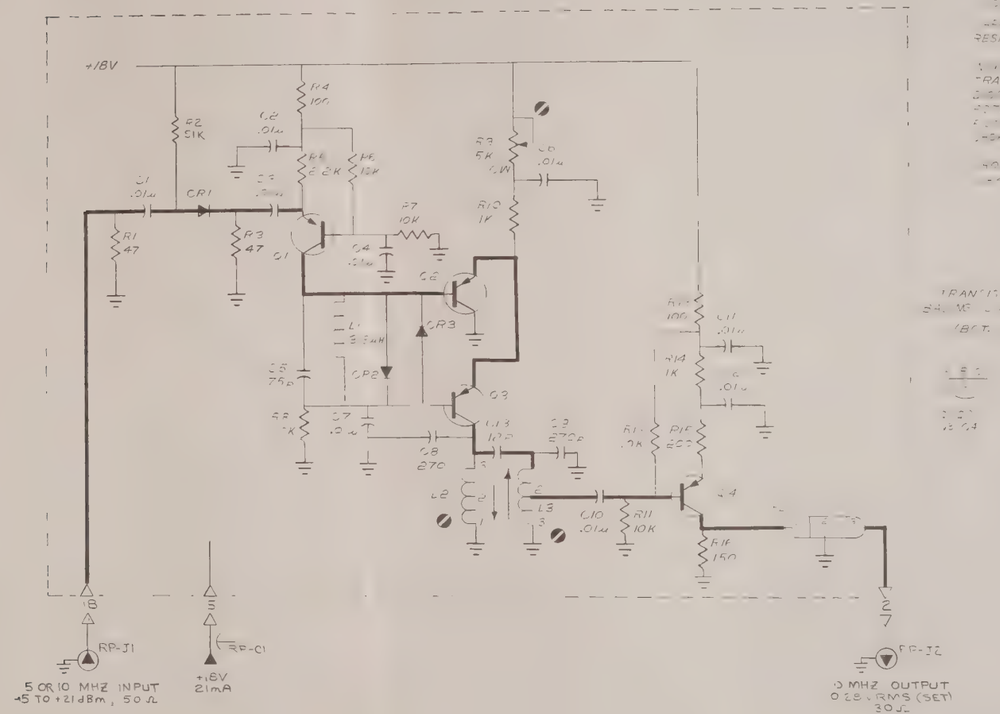


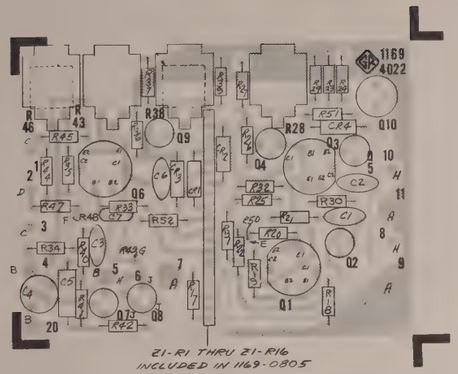
Figure 6-25. Reference Processor — RPA (P/N 1169-4046).

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4022 SEARCH/SWEEP BOARD					
CAPACITORS					
C1 and					
C2	Cer., 100 pF ±10% 500 V	4404-1108	72982	831,.100 pF ±5%	
C3	Cer., 47 pF ±5% 500 V	4404-0475	72982	831, 47 pF ±5%	
C4	Tant., 100 uF ±20% 20 V	4450-6253	83740	C, 100 uF ±20%	
C5	Tant., 1.5 uF ±20% 20 V	4450-4400	56289	150D155Y0020A2	5910-670-7525
C6	100 pF ±10% 500 V	4404-1108	72982	831, 100 pF ±10%	
C7	220 pF ±10% 500 V	4404-1228	72982	831, 220 pF ±10%	
DIODES					
CR1 thru					
CR4	Type 1N3604	6082-1001	24446	1N3604	5961-995-2199
RESISTORS					
R17	Comp., 30 kilohms, ±5% 1/4 W	6099-3305	01121	RCR07G-303J	5905-803-2908
R18	Comp., 6.2 kilohms, ±5% 1/4 W	6099-2625	01121	RCR07G-626J	5905-682-4100
R19	Comp., 11 kilohms, ±5% 1/4 W	6099-3115	01121	RCR07G-113J	
R20	Comp., 100 kilohms, ±5% 1/4 W	6099-4105	01121	RCR07G-104J	5905-686-3129
R21	Comp., 1 kilohm, ±5% 1/4 W	6099-2105	01121	RCR07G-102J	5905-681-6422
R22	Comp., 10 kilohms, ±5% 1/4 W	6099-3105	01121	RCR07G-103J	5905-683-2238
R23	Comp., 5.1 kilohms, ±5% 1/4 W	6099-2515	01121	RCR07G-512J	5905-683-2241
R24	Comp., 11 kilohms, ±5% 1/4 W	6099-3115	01121	RCR07G-113J	
R25	Comp., 100 kilohms, ±5% 1/4 W	6099-4105	01121	RCR07G-104J	5905-686-3129
R26	Comp., 68 kilohms, ±5% 1/4 W	6099-3685	01121	RCR07G-683J	5905-681-8853
R27	Comp., 3 kilohms, ±5% 1/4 W	6099-2305	01121	RCR07G-302J	5905-682-4097
R28	Pot. comp., 1 kilohm, ±20% 25 W	6040-0400	01121	FWC, 1 kilohm, ±20%	
R29	Comp., 13 kilohms, ±5% 1/4 W	6099-3135	01121	RCR07G-133J	5905-702-4437
R30	Comp., 1 kilohm, ±5% 1/4 W	6099-2105	01121	RCR07G-102J	5905-681-6422
R31	Comp., 100 kilohms, ±5% 1/4 W	6099-4105	01121	RCR07G-104J	5905-686-3129
R32 and					
R33	Comp., 10 kilohms, ±5% 1/4 W	6099-3105	01121	RCR07G-103J	5905-683-2238
R34	Comp., 11 kilohms, ±5% 1/4 W	6099-3115	01121	RCR07G-113J	
R35	Comp., 100 kilohms, ±5% 1/4 W	6099-4105	01121	RCR07G-104J	5905-686-3129
R36	Comp., 56 ohms, ±5% 1/4 W	6099-0565	01121	RCR07G-560J	
R37	Comp., 16 kilohms, ±5% 1/4 W	6099-3165	01121	RCR07G-163J	
R38	Comp., 500 ohms, ±20% 25 W	6040-0300	01121	FWC, 500 ohms, ±20%	5905-072-7795
R39 and					
R40	Comp., 1 kilohm, ±5% 1/4 W	6099-2105	01121	RCR07G-102J	5905-681-6422
R41	Comp., 10 kilohms, ±5% 1/4 W	6099-3105	01121	RCR07G-103J	5905-683-2238
R42	Comp., 13 kilohms, ±5% 1/4 W	6099-3135	01121	RCR07G-133J	5905-702-4439
R43	Pot. comp., 1 kilohm, ±20% 25 W	6040-0400	01121	FWC, 1 kilohm, ±20%	
R44	Comp., 1.5 kilohms, ±5% 1/4 W	6099-2155	01121	RCR07G-152J	
R45	Comp., 1.1 kilohms, ±5% 1/4 W	6099-2115	01121	RCR07G-112J	
R46	Pot. comp., 1 kilohm, ±20% 25 W	6040-0400	01121	FWC, 1 kilohm, ±20%	
R47	Comp., 30 kilohms, ±5% 1/4 W	6099-3305	01121	RCR07G-303J	5905-803-2908
R48	Comp., 270 kilohms, ±5% 1/4 W	6099-4275	01121	RCR07G-274J	
R49	Comp., 30 kilohms, ±5% 1/4 W	6099-3305	01121	RCR07G-303J	5905-803-2908
R50	Comp., 18 kilohms, ±5% 1/4 W	6099-3185	01121	RCR07G-183J	5905-687-0000
R51	Comp., 1 megohm, ±5% 1/4 W	6099-5105	01121	RCR07G-105J	
R52	Comp., 220 ohms, ±5% 1/4 W	6099-1225	01121	RCR07G-221J	5905-683-2240
Z1	Network, Thin Film	1169-0805	24655	1169-0805	

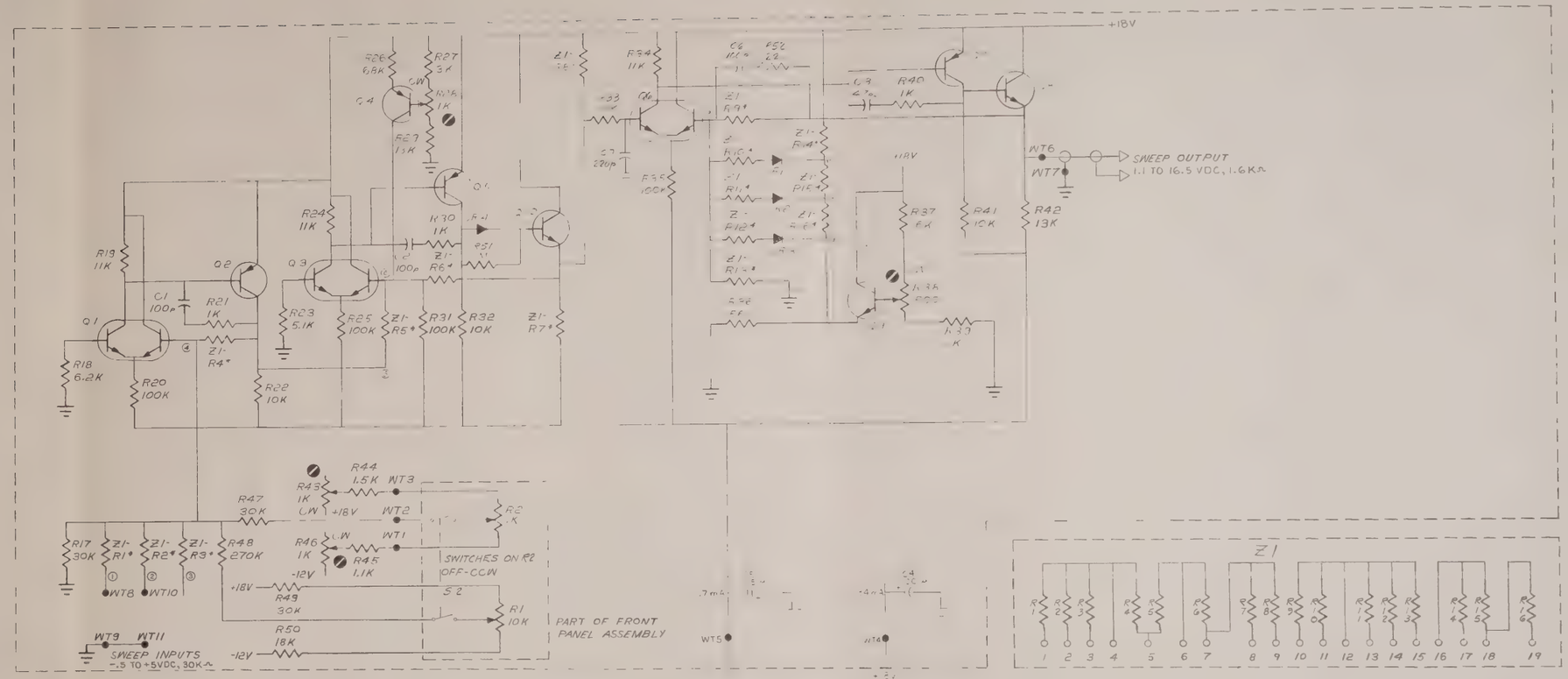
ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
TRANSISTORS					
Q1	Type TD-100	8210-1130	56289	TD-100	
Q2	Type 2N4250	8210-1135	07263	2N4250	
Q3	Type TD-100	8210-1130	56289	TD-100	
Q4	Type 2N3905	8210-1114	04713	2N3905	
Q5	Type 2N4250	8210-1135	07263	2N4250	
Q6	Type TD-100	8210-1130	56289	TD-100	
Q7	Type 2N4250	8210-1135	07263	2N4250	
Q8	Type 2N3903	8210-1132	04713	2N3903	
Q9	Type 2N3391A	8210-1092	24454	2N3391A	
Q10	Type 2N3903	8210-1132	04713	2N3903	



Etched-circuit diagram, Search/Sweep Driver board — SSA (P/N 1169-4022).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.



COMPONENTS USED:

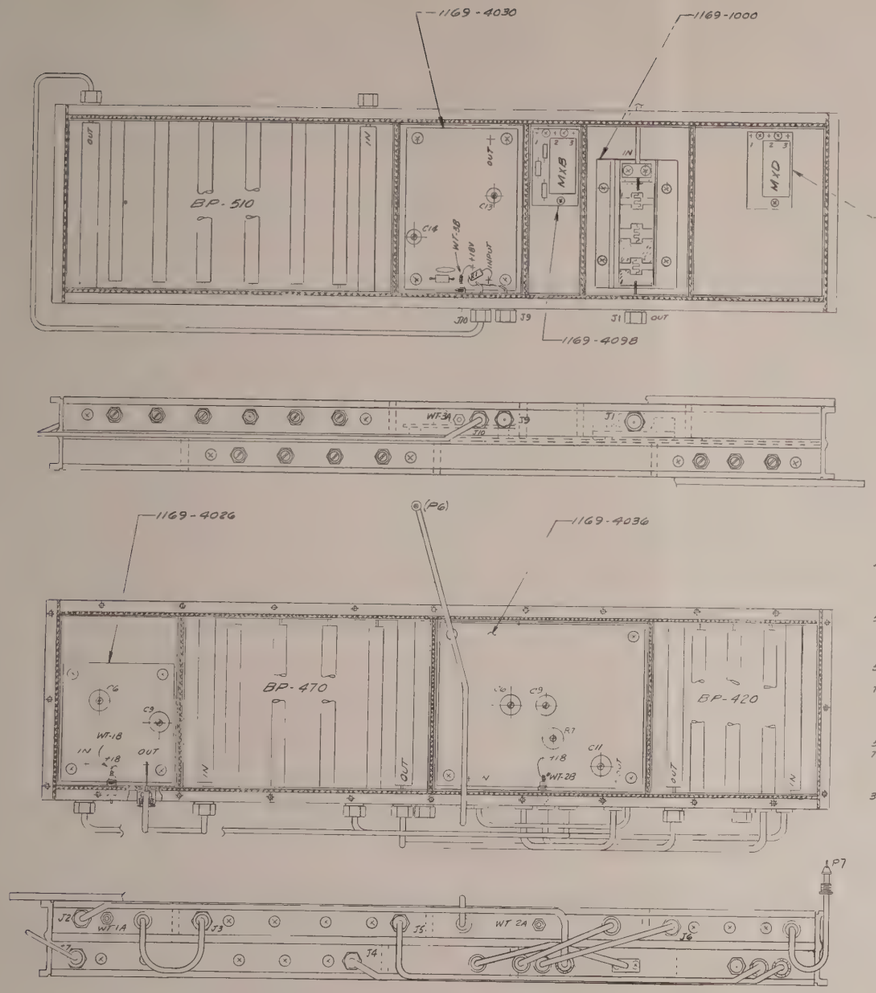
CAPACITORS: C1-C7
RESISTOR NETWORK: Z1
RESISTORS: R1 THRU R52
DIODES: CR1 THRU CR4
TRANSISTORS: Q1 THRU Q10

NOTE: ⓝ TERMINAL NUMBERS ON RESISTOR NETWORK
Z1 R ♦ RESISTORS ON THIN FILM NETWORK (1169-0805)

TRANSISTOR BASE DIAGRAMS

Q9 Q4,Q8,Q10 Q1,Q3,Q6 Q2,Q5,Q7

Figure 6-26. Search/sweep driver — SSA. (P/N 1169-4022)



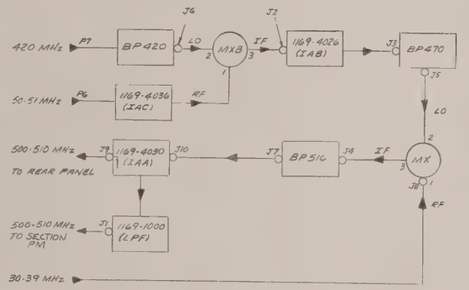
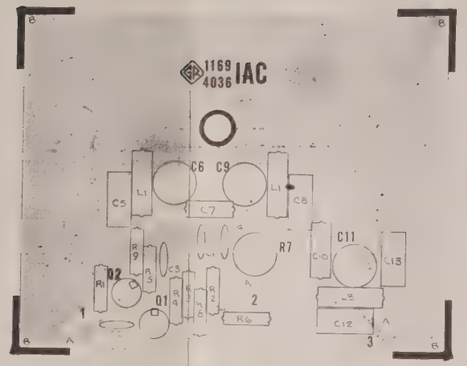
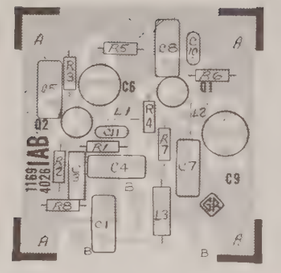


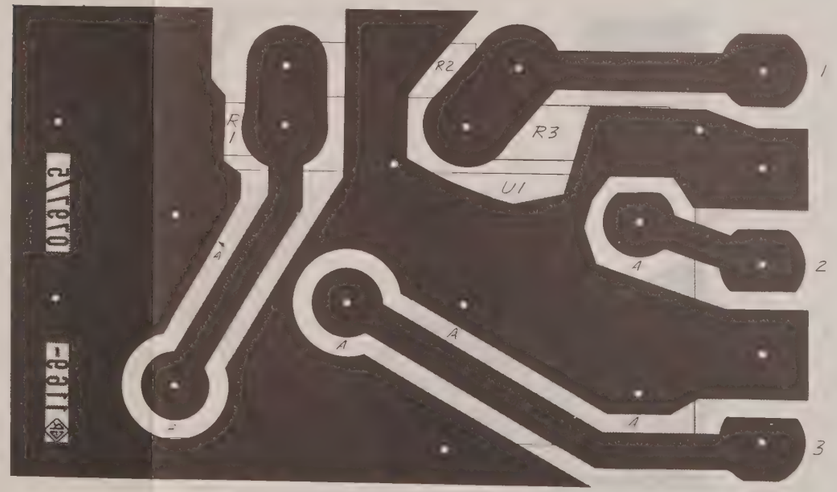
Figure 6-27. UHF Section assembly (P/N 1169-4140).



Etched-circuit diagram, Amplifier board – IAC (P/N 1169-4036).



Etched-circuit diagram, Amplifier board – IAB (P/N 1169-4026).

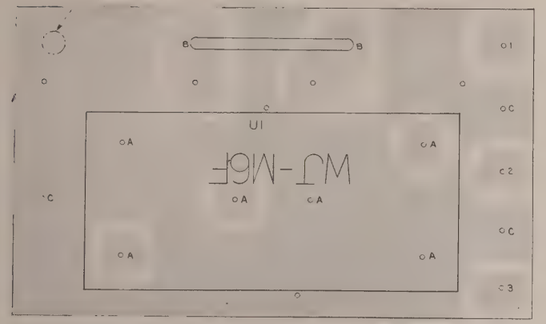


Etched-circuit diagram, Mixer board – MXB (P/N 1169-4098).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4140 UHF ASSEMBLY					
CONNECTORS					
J1 thru J10	Filter	1452-1101	24655	1452-1101	
RESISTOR					
R1	Comp., 22 ohms, ±5% 1/8 W	6098-0225	01121	RCR05G-220J	
1169-4095 MIXER ASM (MXD)					
INTEGRATED CIRCUITS					
U1	Mixer, Type M9B	5434-0111	21424	M9B	
1169-4098 MIXER BOARD ASM XA (470 MHz OUTPUT)					
INTEGRATED CIRCUIT					
U1	Mixer, Type M6F	5434-0100	23367	M6F	
RESISTORS					
R1	Comp., 430 ohms, ±5% 1/4 W	6099-1435	01121	RCR07G-431J	
R2	Comp., 12 ohms, ±5% 1/4 W	6099-0125	01121	RCR07G-120J	
R3	Comp., 430 ohms, ±5% 1/4 W	6099-1435	01121	RCR07G-431J	



Etched-circuit diagram, Mixer board — MXD. (P/N 1169-4095)

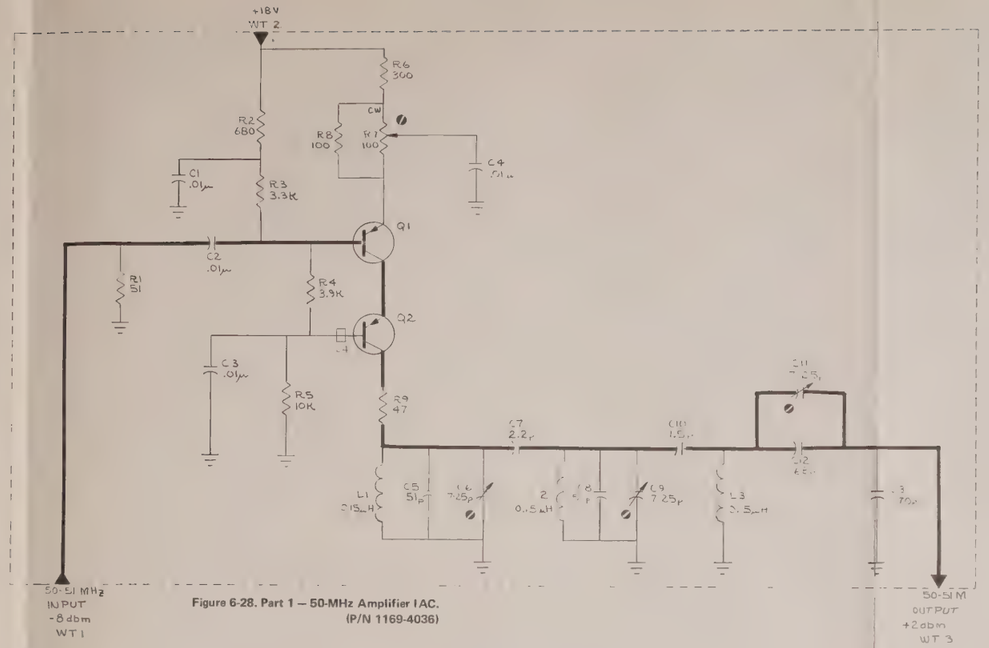


Figure 6-28. Part 1 — 50-MHz Amplifier IAC. (P/N 1169-4036)

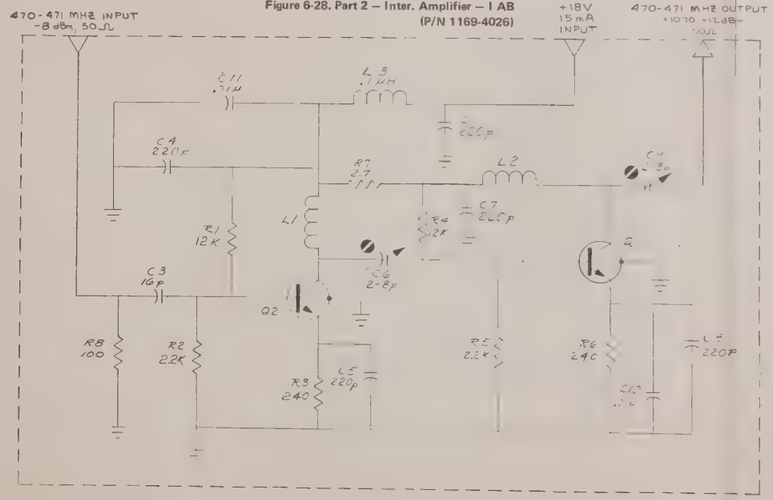


Figure 6-28. Part 2 — Inter. Amplifier — I AB (P/N 1169-4026)

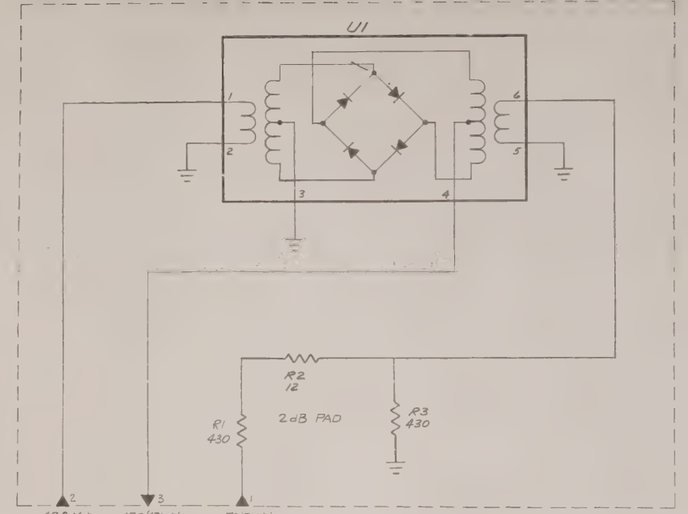
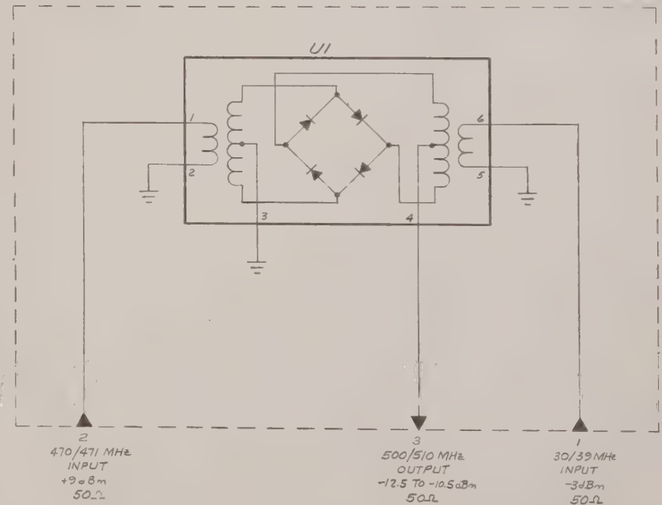


Figure 6-29. Part 1. Mixer — (470-MHz output) MXB. (P/N 1169-4098)

Figure 6-29. Part 2. Mixer — (510-MHz output) MXD. (P/N 1169-4095)



ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4030 INTERMEDIATE AMPLIFIER BOARD (1AA)					
CAPACITORS					
C1	Cer., 10 pF ±5% 500 V N030	4411-0105	72982	831, 10 pF ±5%	
C2 and					
C3	Cer., 1000 pF ±10% 500 V	4404-2108	72982	801, 1000 pF ±10%	
C4	Cer., 18 pF ±5% 500 V NPO	4410-0185	72982	801, 18 pF ±5%	
C5 and					
C6	Cer., 1000 pF ±10% 500 V	4404-2108	72982	801, 1000 pF ±10%	
C7	Cer., 100 pF ±5% 500 V	4404-1105	72982	831, 100 pF ±5%	
C8	Cer., 1000 pF ±10% 500 V	4404-2108	72982	801, 1000 pF ±10%	
C9	Cer., .001 uF +100-0% 300 V	4400-5700	00656	BC-C1-2-NM	
C10	Cer., 100 pF ±5% 500 V	4404-1105	72982	831, 100 pF ±5%	
C11	Cer., .01 uF +80-20% 100 V	4401-3100	80131	CC61, .01 uF +80-20%	5910-974-5697
C12	Cer., 3.0 pF ±5% N30	4411-0035	80131	CC60, 3.0 pF ±5%	
C13 and					
C14	Trimmer, 3.5-13 pF	4910-2071	72982	TS-TR1KO-02	
C15	Cer., 82 pF ±5% 500 V	4400-1240	95121	QC,,82 pF ±5%	
C16	Cer., 1000 pF ±10% 500 V	4404-2108	72982	801, 1000 pF ±10%	
INDUCTORS					
L1 and					
L2	Coil	1169-6031	24655	1169-6031	
L3	Coil	1169-6032	24655	1169-6032	
RESISTORS					
R1	Comp., 10 ohms, ±5% 1/4 W	6099-0105	01121	RCR07G-100J	5905-809-8596
R2	Comp., 3.9 kilohms, ±5% 1/4 W	6099-2395	01121	RCR07G-392J	
R3	Comp., 6.8 kilohms, ±5% 1/4 W	6099-2685	01121	RCR07G-682J	5905-686-9997
R4	Comp., 470 ohms, ±5% 1/4 W	6099-1475	01121	RCR07G-471J	5905-683-2242
R5	Comp., 22 ohms, ±5% 1/4 W	6099-0225	01121	RCR07G-220J	5905-755-8389
R6 and					
R7	Comp., 3.9 kilohms, ±5% 1/4 W	6099-2395	01121	RCR07G-392J	
R8	Pot. comp., 10 kilohms, ±20%	6040-0700	01121	FWC, 10 kilohms, ±20%	
R9	Pot comp., 10 ohms, ±5% 1/4 W	6099-0105	01121	RCR07G-100J	5905-809-8596
R10	Pot. comp., 3.9 kilohms, ±5% 1/4 W	6099-2395	01121	RCR07G-392J	
R11	Pot. comp., 1.8 kilohms, ±5% 1/4 W	6099-2185	01121	RCR07G-182J	5905-688-3738
R12	Pot. comp., 47 ohms, ±5% 1/4 W	6099-0475	01121	RCR07G-470J	
R13	Pot. comp., 22 ohms, ±5% 1/4 W	6099-0225	01121	RCR07G-220J	5905-755-8389
R14	Pot. comp., 430 ohms, ±5% 1/4 W	6099-1435	01121	RCR07G-431J	
R15	Pot. comp., 270 ohms, ±5% 1/4 W	6099-1275	01121	RCR07G-271J	
R16	Pot comp., 100 ohms, ±5% 1/4 W	6099-1105	01121	RCR07G-101J	
R17 and					
R18	Pot. comp., 4.7 ohms, ±5% 12 W	6098-9475	01121	RCR07G-4R7J	
TRANSISTORS					
Q1	Type 2N5179	8210-1195	79089	2N5179	
Q2	Type A485	8210-1194	03715	A485	
Q3	Type 2N5109	8210-1198	79089	2N5109	

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4026 INTERMEDIATE AMPLIFIER BD 1AB					
CAPACITORS					
C1	Mica, 220 pF ±5% 500 V	4700-0519	14655	22A, 220 pF ±5%	
C3	Mica, 16 pF ±5% 500 V	4700-0210	14655	22ASQ16JC	
C4 and					
C5	Mica, 220 pF ±5% 500 V	4700-0519	14655	22A, 220 pF ±5%	
C6	Trimmer cer., 2-8 pF	4910-2045	72982	538-002, 2 to 8 pF	
C7 and					
C8	Mica, 220 pF ±5% 500 V	4700-0519	14655	22A, 220 pF ±5%	
C9	Trimmer cer., 2-8 pF	4910-2045	72982	538-002, 2 to 8 pF	
C10 and					
C11	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
INDUCTORS					
L1	Choke, special	1169-8430	24655	1169-8430	
L2	Choke, special	1169-8450	24655	1169-8450	
RESISTORS					
R1	Comp., 6.2 kilohms, ±5% 1/4 W	6099-2625	01121	RCR07G-622J	5905-682-4100
R2	Comp., 2.2 kilohms, ±5% 1/4 W	6099-2225	01121	RCR07G-222J	5905-723-5251
R3	Comp., 240 ohms, ±5% 1/4 W	6099-1245	01121	RCR07G-241J	
R4	Comp., 4.3 kilohms, ±5% 1/4 W	6099-2435	01121	RCR07G-432J	
R5	Comp., 2.2 kilohms, ±5% 1/4 W	6099-2225	01121	RCR07G-222J	5905-723-5251
R6	Comp., 240 ohms, ±5% 1/4 W	6099-1245	01121	RCR07G-241J	
R7	Comp., 2.7 ohms, ±5% 1/4 W	6099-9275	01121	RCR07G-2R7J	
R8	Comp., 100 ohms, ±5% 1/4 W	6099-1105	01121	RCR07G-101J	
R9	Comp., 240 ohms, ±5% 1/4 W	6099-1245	01121	RCR07G-241J	
TRANSISTORS					
Q1 and					
Q2	Type 2N5179	8210-1195	79089	2N5179	
1169-4036 INTERMEDIATE AMPLIFIER BD 1AC					
CAPACITORS					
C1 thru					
C4	Cer., .01 uF +80-20% 100 V	4401-3100	80131	CC61, .01 uF +80-20%	5910-974-5697
C5	Mica, 51 pF ±5% 500 V	4700-0354	88419	22A5Q51	
C6	Trimmer cer., 7-25 pF	4910-2043	72982	538-002, 7-25 pF	
C7	Tubular, 2.2 pF ±5% 500 V	4400-0205	78488	GA, 2.2 pF	5910-667-6114
C8	Mica, 51 pF ±5% 500 V	4700-0354	88419	22A5Q51	
C9	Trimmer cer., 7-25 pF	4910-2043	72982	538-002, 7-25 pF	
C10	Tubular, 1.5 pF ±5% 500 V	4400-0150	78488	GA, 1.5 pF ±5%	
C11	Trimmer cer., 7-25 pF	4910-2043	72982	538-002, 7-25 pF	
C12	Mica, 68 pF ±5% 500 V	4700-0371	88419	CM22D, 68 pF ±5%	
C13	Mica, 270 pF ±1% 500 V	4710-0450	72136	CM05, 270 pF ±1%	
INDUCTORS					
L1 thru					
L3	Molded, 0.15 uH ±10%	4300-0101	99800	1536, 0.15 uH ±10%	
L4	Ferrite Bead	5000-1250	02114	56-590-65/4B	

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
RESISTORS					
R1	Comp., 51 ohms, ±5% 1/4 W	6099-0515	01121	RCR07G-510J	
R2	Comp., 680 ohms, ±5% 1/4 W	6099-1685	01121	RCR07G-681J	
R3	Comp., 3.3 kilohms, ±5% 1/4 W	6099-2335	01121	RCR07G-332J	5905-681-9969
R4	Comp., 3.9 kilohms, ±5% 1/4 W	6099-2395	01121	RCR07G-392J	
R5	Comp., 10 kilohms, ±5% 1/4 W	6099-3105	01121	RCR07G-103J	5905-683-2238
R6	Comp., 300 ohms, ±5% 1/4 W	6099-1305	01121	RCR07G-301J	5905-279-5481
R7	Pot. cermet, 100 ohms, ±10%	6049-0212	01121	SV101J	
R8	Comp., 100 ohms, ±5% 1/4 W	6099-1105	01121	RCR07G-101J	
R9	Comp., 47 ohms, ±5% 1/4 W	6099-0475	01121	RCR07G-470J	
TRANSISTORS					
Q1	Type 2N4258	8210-1136	07263	2N4258	
Q2	Type 2N3905	8210-1114	04713	2N3905	

Etched-circuit diagram, Intermediate Amplified board — IAA (P/N 1169-4030).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

RESISTANCE IS IN OHMS, $K=10^3$, $M=10^6$
CAPACITANCE IS IN FARADS, $\mu=10^{-6}$, $p=10^{-12}$
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
[ ] = PANEL CONTROL [ ] = REAR CONTROL
⊘ = SCREWDRIVER CONTROL WT = WIRE TIE TP = TEST POINT
COMPLETE REFERENCE DESIGNATION INCLUDES SUBASSEMBLY LETTER C R1 B R1 ETC

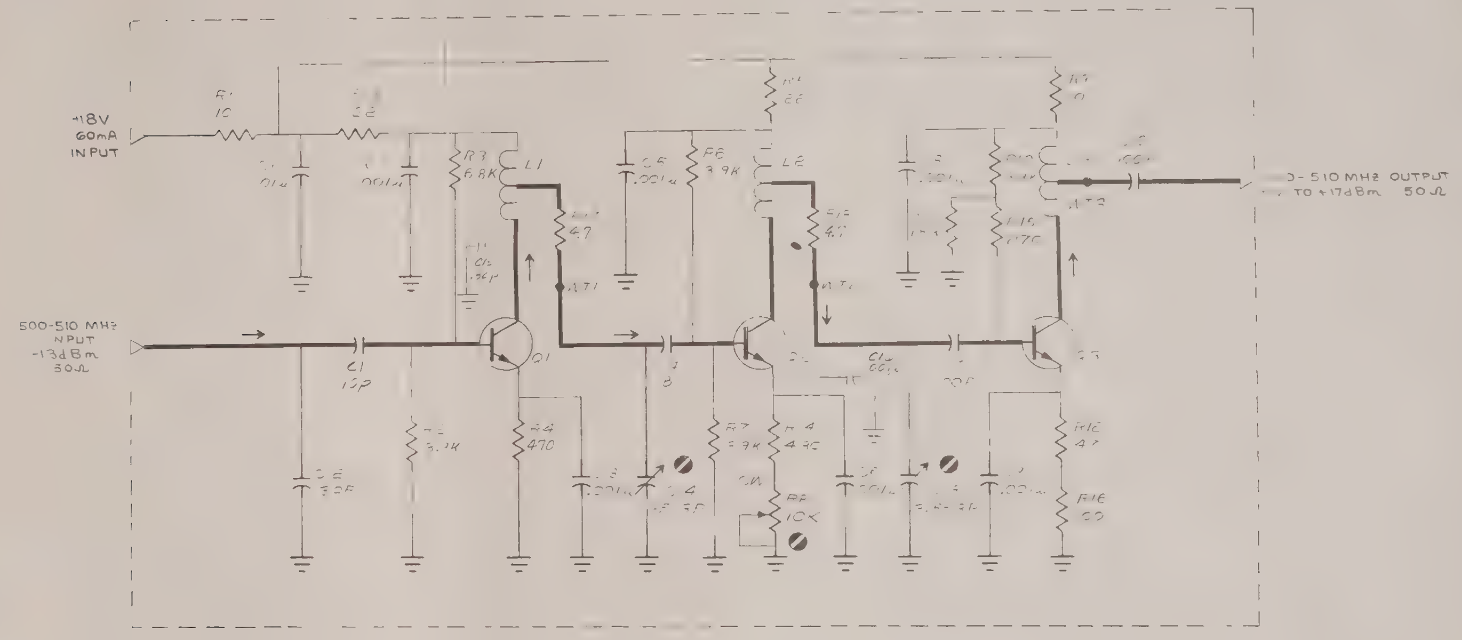
404 F SWITCH NUMBERING
- FRONT, REAR
- CONTACTS, FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS 01
- SECTION, SECTION NEAREST PANEL IS 1.

ROTORS SHOWN CCW

CONNECTIONS
- OUTPUT LEAVES SUBASSEMBLY
- INPUT FROM DIFFERENT SUBASSEMBLY
- OUTPUT REMAINS ON SUBASSEMBLY
- INPUT FROM SAME SUBASSEMBLY

NOTE: EACH TERMINAL NUMBER SHOWN AT THE EDGE OF THE CIRCUIT BLOCK IS IDENTICAL TO THE EXTERNAL TERMINAL NUMBERS MARKED ON THE BOTTOM COVER PLATE OF THE SECTION OF THE INSTRUMENT CONTAINING THE CIRCUIT BOARD

ALL FEED-THROUGH CAPACITORS ARE GROUNDED TO ENCLOSURE AND ARE 1000 pF



COMPONENTS USED:

RESISTORS: R1 THRU R18
CAPACITORS: C1 THRU C16
TRANSISTORS: Q1 THRU Q3
TRANSFORMERS: L1 THRU L3

TRANSISTOR BASE DIAGRAM
(BOTTOM VIEW)

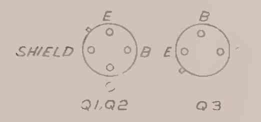


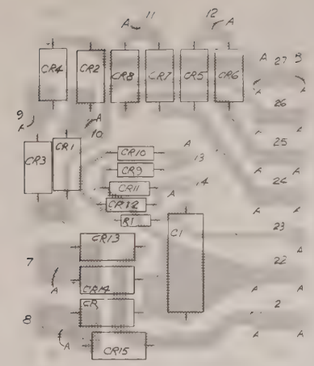
Figure 6-30. 500 — 510-MHz Amplifier IAA. (P/N 1169-4030)

ELECTRICAL PARTS LIST

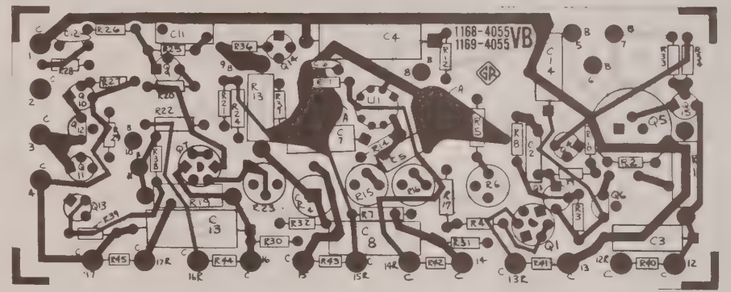
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4110 REAR PANEL + POWER SUPPLY (V)					
CAPACITORS					
C1	Elect., 7500 µF +75-10% 20 V	4450-6222	80183	32D722G0135BA6B	
C2	Elect., 4500 µF +75-10% 40 V	4450-6221	56289	32342G030BA6B	
C3	Elect., 8400 µF +75-10% 40 V	4450-4100	56289	32D	
C4	Mylar, 2.2 µF ±10% 50 V	4860-9853	84411	663UW, 2.2 µF ±10%	
CONNECTORS					
J1	Receptable, Power, C.E.E. Std.	4240-0210	05051	4240-0210	
J2	EC 10 pos DR	4230-5220	95354	81-6020-1100	
J3 thru J5	Connector, Jack	4260-1010	91916	SKT-8	
FUSES					
F1	Slo-Blo 1/2 A	5330-1000	71400	MdL, .5 Amp	5920-199-9498
F2	Slo-Blo 1A	5330-1400	71400	MdL, 1 Amp	5920-852-6322
RESISTORS					
R1 thru R3	Comp., 300 Ω ±5% 1/4 W	6099-1305	75042	BTS, 300 Ω ±5%	5905-279-5481
R4	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
R5	Comp., 10 Ω ±5% 1/4 W	6099-0105	75042	BTS, 10 Ω ±5%	5905-809-8596
SWITCHES					
S1	Line Voltage	7890-1382	76854	82227-H7C	
TRANSISTORS					
Q1 thru Q3	Type 40250	8210-1095	79089	40250	
Q4	Type 2N3055	8210-1097	56232	2N3055	
TRANSFORMERS					
T1	Transformer	0365-4022	24655	0365-4022	
1169-4055 REGULATOR BOARD VB					
CAPACITORS					
C2	Cer., 0.1 uF ±20% 50 V	4400-2050	80183	5C13, .1 uF ±20%	5910-080-4646
C3	Tant., 47 uF ±20% 6 V	4450-5500	56289	150D476X0006B2	5910-752-4185
C4	Tant., 150 uF ±20% 15 V	4450-5705	56289	150D107X0020S3	
C5	Cer., 1 uF ±20% 50 V	4400-2070	80183	5C13, .1 uF ±20%	5910-083-6445
C6	Cer., 1000 pF ±20% 500 V	4404-2100	72982	831, 1000 pF ±20%	
C7	Tant., 6.8 uF ±2% 35 V	4450-5000	56289	150D685X0035B2	5910-814-5869
C8	Tant., 47 uF ±20% 20 V	4450-5614	56289	150D4760020R2	
C11	Cer., 0.1 uF ±20% 50 V	4400-2050	80183	5C13, .1 uF ±20%	5910-080-4646
C12	Cer., .01 uF +80-20% 100 V	4401-3100	72982	805, .01 uF +80-20%	5910-974-5697
C13	Tant., 47 uF ±20% 20 V	4450-5614	56289	150D4760020R2	
C14	Tant., 15 uF ±20% 20 V	4450-5200	56289	150D156X0020B2	
DIODES					
CR4	Type 1N91	6081-1009	24446	1N91	5960-677-4865
INTEGRATED CIRCUITS					
U1	Type MC1469R	5432-1013	04713	MC1469R	
RESISTORS					
R1	WW, 0.68 ohms, ±5% 2 W	6760-8685	75042	CEA, 68 ohms, ±5%	
R2	Comp., 100 ohms, ±5% 1/4 W	6099-1105	01121	RCR07G-101J	
R3	Comp., 20 kilohms, ±5% 1/4 W	6099-3205	01121	RCR07G-203J	5905-686-3368
R4	Comp., 12 kilohms, ±5% 1/4 W	6099-3125	01121	RCR07G-123J	
R5	Film, 1.40 kilohms, ±1% 1/8 W	6250-1140	75042	CEA, 1.40 kilohms, ±1%	
R6	Pot. W.W., 100 ohms, ±10%	6060-0230	06704	100 ohms, ±10%	
R7	Film, 3.01 kilohms, ±1% 1/8 W	6250-1301	75042	CEA, 3.01 kilohms, ±1%	5905-702-5974
R8	Comp., 1.3 kilohms, ±5% 1/4 W	6099-2135	01121	RCR07G-135J	5905-686-3119

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
RESISTORS (cont)					
R9	Comp., 2 kilohms, ±5% 1/4 W	6099-2205	01121	RCR07G-202J	5905-686-3370
R10	Comp., 12 kilohms, ±5% 1/4 W	6099-3125	01121	RCR07G-123J	
R11	Comp., 2.7 kilohms, ±5% 1/4 W	6099-2275	01121	RCR07G-272J	
R12	Comp., 100 ohms, ±5% 1/4 W	6099-1105	01121	RCR07G-101J	
R13	W.W., 1.1 ohms, ±5% 2 W	6760-9115	01121	CEA, 1.1 ohm, ±5%	
R14	Film, 8.66 kilohms, ±1% 1/8 W	6250-1866	01121	CEA, 8.66 kilohms, ±1%	5905-755-8130
R15	Pot. W.W., 1 kilohm, ±10%	6060-0232	08848	1 kilohm, ±10%	
R16	Pot. W.W., 100 ohms, ±10%	6060-0230	06704	100 ohms, ±10%	
R17	Film, 3.01 kilohms, ±1% 1/8 W	6250-1301	75042	CEA, 3.01 kilohms, ±1%	5905-702-5974
R19	W.W., 0.68 ohms, ±5% 2 W	6760-8685	75042	CEA, 68 ohms, ±5%	
R20	Comp., 20 kilohms, ±5% 1/4 W	6099-3205	01121	RCR07G-203J	5905-686-3368
R21	Comp., 12 kilohms, ±5% 1/4 W	6099-3125	01121	RCR07G-123J	
R22	Film, 13.3 kilohms, ±1% 1/8 W	6250-2133	75042	CEA, 13.3 kilohms, ±10%	
R23	Pot. W.W., 500 ohms, ±10%	6060-0231	06704	500 ohms, ±10%	
R24	Film, 8.66 kilohms, ±1% 1/8 W	6250-1866	75042	CEA, 8.66 kilohms, ±1%	5905-755-8130
R25	Comp., 51 ohms, ±5% 1/4 W	6099-0515	01121	RCR07G-510J	
R26	Comp., 2 kilohms, ±5% 1/4 W	6099-2205	01121	RCR07G-202J	5905-686-3370
R27	Comp., 12 kilohms, ±5% 1/4 W	6099-3125	01121	RCR07G-123J	
R28	Comp., 510 ohms, ±5% 1/4 W	6099-1515	01121	RCR07G-511J	5905-801-8272
R29	Comp., 220 ohms, ±5% 1/4 W	6099-1225	01121	RCR07G-221J	5905-683-2240
R30	Comp., 100 ohms, ±5% 1/4 W	6099-1105	01121	RCR07G-101J	
R31 and R32	Comp., 2.7 ohms, ±5% 1/4 W	6099-9275	01121	RCR07G-2R7J	
R33	Comp., 1.5 kilohms, ±5% 1/4 W	6099-2155	01121	RCR07G-152J	
R34	Comp., 10 kilohms, ±5% 1/4 W	6099-3105	01121	RCR07G-103J	5905-683-2238
R36	Comp., 1.5 kilohms, ±5% 1/4 W	6099-2155	01121	RCR07G-152J	
R37	Comp., 27 kilohms, ±5% 1/4 W	6099-3275	01121	RCR07G-273J	5905-683-3838
R38	Comp., 1.5 kilohms, ±5% 1/4 W	6099-2155	01121	RCR07G-152J	
R39	Comp., 30 kilohms, ±5% 1/4 W	6099-3305	01121	RCR07G-303J	5905-803-2908
R40 thru R45	Comp., 10 ohms, ±5% 1/4 W	6099-0105	01121	RCR07G-100J	5905-809-8596
TRANSISTORS					
Q1	Type TD-100	8210-1130	56289	TD-100	
Q3	Type 2N3905	8210-1114	04713	2N3905	5961-847-9782
Q4	Type 2N3391A	8210-1092	24454	2N3391A	
Q5	Type 2N697	8210-1040	49956	2N697	5961-752-0150
Q6	Type 2N5457	8210-1157	04713	2N5457	
Q7	Type TD-100	8210-1130	56289	TD-100	
Q9	Type 2N3905	8210-1114	04713	2N3905	5961-847-9782
Q10 and Q11	Type 2N3391A	8210-1092	24454	2N3391A	
Q12	Type 2N5457	8210-1157	04713	2N5457	
Q13 thru Q15	Type 2N3391A	8210-1092	24454	2N3391A	
RECTIFIER BOARD VA (P/N 1169-4050)					
CAPACITORS					
C1	Tant., 120 uF ±20% 10 V	4450-5616	56289	150D127X0010R2	
DIODES					
CR1 thru CR8	Type 1N4140	6081-1014	13327	1N4140	
CR9 thru CR12	Type 1N645	6082-1016	24446	1N645	5961-087-6047
CR13 thru CR16	Type 1N4140	6081-1014	13327	1N4140	
RESISTORS					
R1	Comp., 4.7 ohms, ±5% 1/4 W	6099-9475	01121	RCR07G-4R7J	



Etched-circuit diagram, Rectifier board — VA (P/N 1169-4050).



Etched-circuit diagram, Regulator board — VB (P/N 1169-4055).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

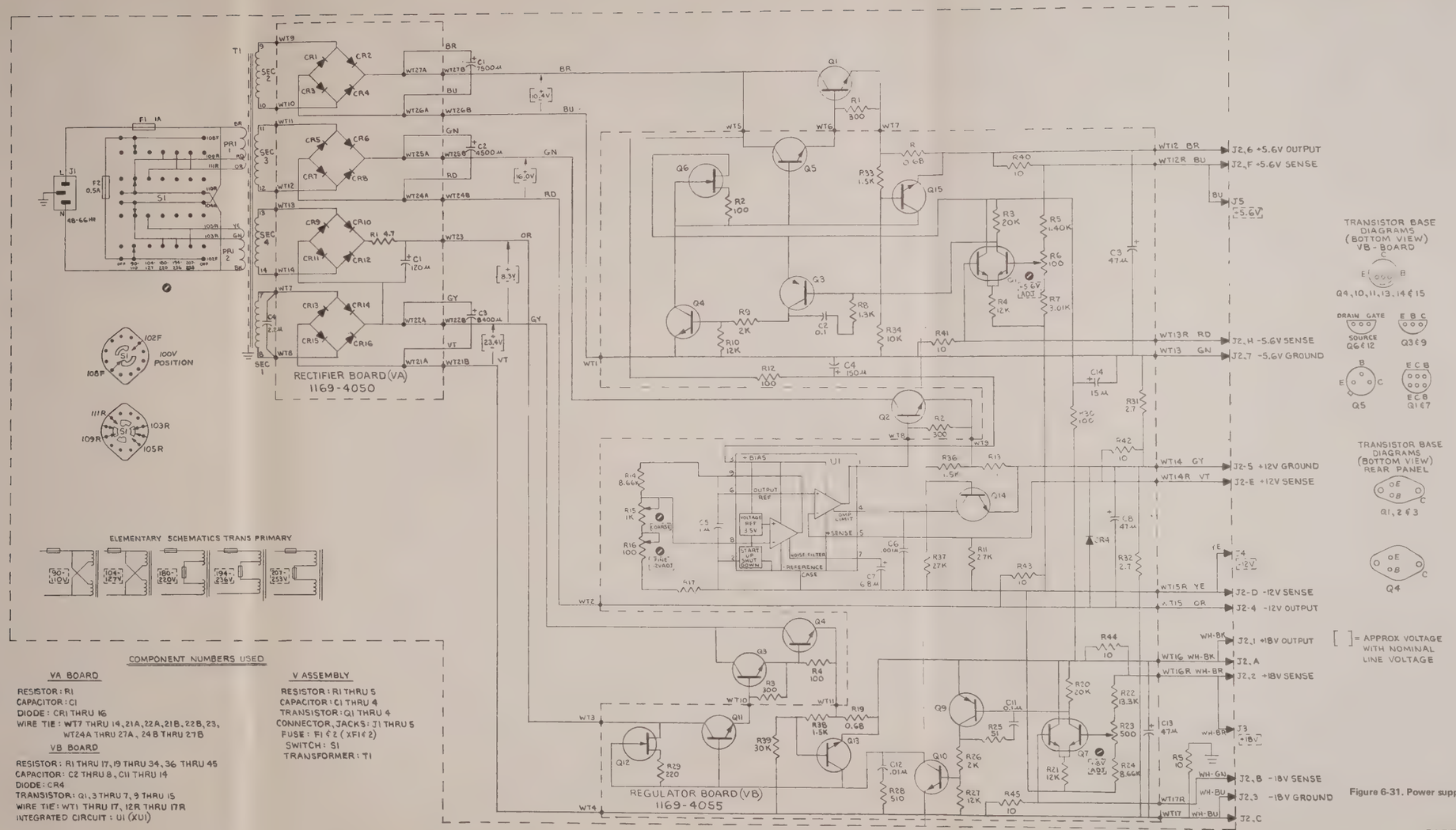

RESISTANCE IS IN OHMS, K=10³, M=10⁶
CAPACITANCE IS IN FARADS, μ=10⁻⁶, p=10⁻¹²
VOLTAGES EXPLAINED IN INSTRUCTION BOOK SERVICE NOTES
PANEL CONTROL
REAR CONTROL
SCREWDRIVER CONTROL. WT=WIRE TIE. TP=TEST POINT.
COMPLETE REFERENCE DESIGNATION. INCLUDES SUBASSEMBLY LETTER, C-R1, B-R1, ETC.
4 0 4 F
SWITCH NUMBERING
FRONT, REAR
CONTACTS, FIRST CONTACT CW FROM STRUT SCREW ABOVE KEY IS 01.
SECTION, SECTION NEAREST PANEL IS 1.
ROTORS SHOWN CCW
CONNECTIONS
OUTPUT LEAVES SUBASSEMBLY
INPUT FROM DIFFERENT SUBASSEMBLY
OUTPUT REMAINS ON SUBASSEMBLY
INPUT FROM SAME SUBASSEMBLY
RECTIFIER BOARD (VA) 1169-4050
REGULATOR BOARD (VB) 1169-4055
100V POSITION
ELEMENTARY SCHEMATICS TRANS PRIMARY
J2,6 +5.6V OUTPUT
J2,F +5.6V SENSE
J5 +5.6V
J2,H -5.6V SENSE
J2,7 -5.6V GROUND
J2-5 +12V GROUND
J2-E +12V SENSE
J2-D -12V SENSE
J2-4 -12V OUTPUT
J2,1 +18V OUTPUT
J2,A
J2,2 +18V SENSE
J3 +18V
J2,B -18V SENSE
J2,3 -18V GROUND
J2,C
TRANSISTOR BASE DIAGRAMS (BOTTOM VIEW) VB-BOARD
Q4,10,11,13,14 & 15
Q5
Q3 & 9
Q1 & 7
TRANSISTOR BASE DIAGRAMS (BOTTOM VIEW) REAR PANEL
Q1,2 & 3
Q4
[ ] = APPROX VOLTAGE WITH NOMINAL LINE VOLTAGE
COMPONENT NUMBERS USED
VA BOARD
RESISTOR: R1
CAPACITOR: C1
DIODE: CR1 THRU 16
WIRE TIE: WT7 THRU 14, 21A, 22A, 21B, 22B, 23, WT24A THRU 27A, 24B THRU 27B
VB BOARD
RESISTOR: R1 THRU 17, 19 THRU 34, 36 THRU 45
CAPACITOR: C2 THRU 8, C11 THRU 14
DIODE: CR4
TRANSISTOR: Q1, 3 THRU 7, 9 THRU 15
WIRE TIE: WT1 THRU 17, 12R THRU 17R
INTEGRATED CIRCUIT: U1 (XU1)
V ASSEMBLY
RESISTOR: R1 THRU 5
CAPACITOR: C1 THRU 4
TRANSISTOR: Q1 THRU 4
CONNECTOR, JACKS: J1 THRU 5
FUSE: F1 & 2 (XF1 & 2)
SWITCH: S1
TRANSFORMER: T1

Figure 6-31. Power supply -- V. (P/N 1169-4110).

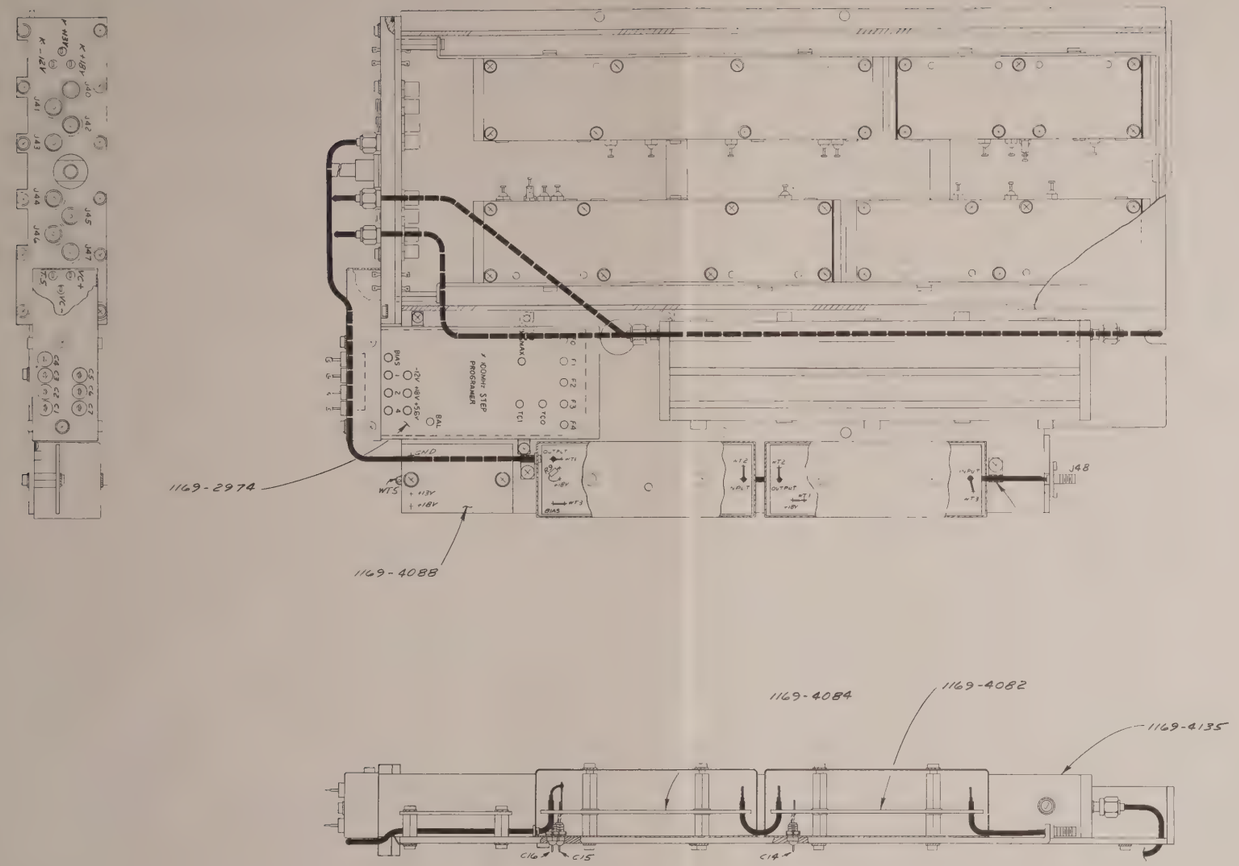
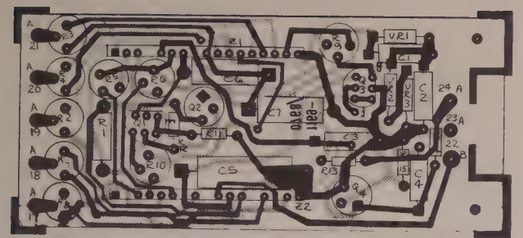


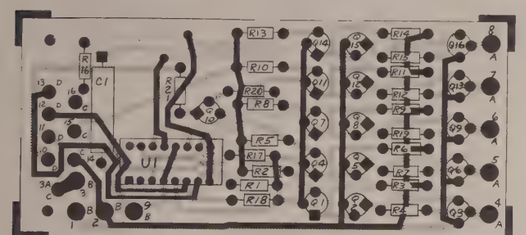
Figure 6-32. Microwave Section assembly (K).

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4074 STEP PROGRAM BD (KE)					
CAPACITORS					
C1	Tant., 47 μF ±2% 6V	4450-5500	56289	150D476X0006B2	5910-752-4185
INTEGRATED CIRCUIT					
U1	Digital	5431-8041	96214	SN74141N	
RESISTORS					
R1	Comp., 2.2 kΩ 5% 1/4 W	6099-2225	75042	BTS, 2.2 kΩ ±5%	5905-723-5251
R2	Comp., 22 kΩ ±5% 1/4 W	6099-3225	75042	BTS, 22 kΩ ±5%	5905-687-0002
R3	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R4	Comp., 22 kΩ ±5% 1/4 W	6099-3225	75042	BTS, 22 kΩ ±5%	
R5	Comp., 22 kΩ ±5% 1/4 W	6099-3225	75042	BTS, 22 kΩ ±5%	5905-687-0002
R6	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R7	Comp., 22 kΩ ±5% 1/4 W	6099-3225	75042	BTS, 22 kΩ ±5%	
R8	Comp., 22 kΩ ±5% 1/4 W	6099-3225	75042	BTS, 22 kΩ ±5%	5905-687-0002
R9	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R10	Comp., 22 kΩ ±5% 1/4 W	6099-3225	75042	BTS, 22 kΩ ±5%	5905-687-0002
R11	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R12	Comp., 22 kΩ ±5% 1/4 W	6099-3225	75042	BTS, 22 kΩ ±5%	
R13	Comp., 22 kΩ ±5% 1/4 W	6099-3225	75042	BTS, 22 kΩ ±5%	5905-687-0002
R14	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R15	Comp., 22 kΩ ±5% 1/4 W	6099-3225	75042	BTS, 22 kΩ ±5%	5905-687-0002
R16	Comp., 15 Ω ±5% 1/4 W	6099-0155	75042	BTS, 15 Ω ±5%	
R17 and R18	Comp., 2.2 kΩ ±5% 1/4 W	6099-2225	75042	BTS, 2.2 kΩ ±5%	5905-723-5251
R19	Comp., 22 kΩ ±5% 1/4 W	6099-3225	75042	BTS, 22 kΩ ±5%	
R20	Comp., 3.3 kΩ ±5% 1/4 W	6099-2335	75042	BTS, 3.3 kΩ ±5%	5905-681-9969
R21	Comp., 100 Ω ±5% 1/4 W	6099-1105	75042	BTS, 100 Ω ±5%	
TRANSISTORS					
Q1	Type 2N4125	8210-1125	04713	2N4125	
Q2	Type 2N4123	8210-1123	04713	2N4123	
Q3	Type 2N4861	8210-1221	96214	2N4861	
Q4	Type 2N4125	8210-1125	04713	2N4125	
Q5	Type 2N4123	8210-1123	04713	2N4123	
Q6	Type 2N4861	8210-1221	96214	2N4861	
Q7	Type 2N4125	8210-1125	04713	2N4125	
Q8	Type 2N4123	8210-1123	04713	2N4123	
Q9	Type 2N4861	8210-1221	96214	2N4861	
Q10	Type 2N4125	8210-1125	94713	2N4125	
Q11	Type 2N4123	8210-1125	04713	2N4125	
Q12	Type 2N4861	8210-1123	04713	2N4123	
Q13	Type 2N4125	8210-1221	96214	2N4861	
Q14	Type 2N4125	8210-1125	04713	2N4125	
Q15	Type 2N4125	8210-1123	04713	2N4123	
Q16	Type 2N4861	8210-1221	96214	2N4861	
1169-4068 100 MHz STEP PROGRAM BOARD (KF)					
CAPACITORS					
C1	Cap. Tant., 4.7 μF ±20% 10 V	4450-4700	07536	4450-4700	
C2 thru C4	Cap. Tant., 3.3 μ20% 15V	4450-4600	02195	15335C2	
C5	Cap. Tant., 180 μF ±20% 6 V	4450-5617	56289	150D187X0006R2	
C6 and C7	Cap. Tant., 4.7 μF ±20% 50 V	4450-4990	56289	150D475X0050B2	
DIODES					
VR1 thru VR3		6083-1060	75042	IN825	
RESISTORS					
R1	Comp., 620 Ω ±5% 1/2 W	6100-1625	01121	RC20GF621J	5905-279-1761
R2 thru R4	Pot. W.W., 1 kΩ ±5%	6060-0232	03902	3305P, 1 kΩ ±5%	
R5 and R6	Pot. W.W., 500 Ω ±5%	6060-0231	03902	3305P, 500 Ω ±5%	
R7 thru R10	Pot. W.W., 1 kΩ ±5%	6060-0232	03902	3305P, 1 kΩ ±5%	
R11	Comp., 22 kΩ ±5% 1/4 W	6099-3225	75042	BTS, 22 kΩ ±5%	5905-687-0002
R12	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R13	Comp., 56 kΩ ±5% 1/4 W	6099-3565	75042	BTS, 56 kΩ ±5%	5905-800-0179
R14	Comp., 2.4 kΩ ±5% 1/4 W	6099-2245	75042	BTS, 2.4 kΩ ±5%	5905-683-7724
R15	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
RESISTOR NETWORKS					
Z1	Thin Film	1169-0815	24655		
Z2	Thin Film	1169-0820	24655	1169-0820	
TRANSISTORS					
Q1	Type TD-100	8210-1130	56289	TD-100	
Q2	Type 2N4125	8210-1125	04713	2N4125	
Q3	Type TD-400	8210-1169	80183	TD-400	
Q4	Type 2N4123	8210-1123	04713	2N4123	



Etched-circuit diagram 100-MHz Step Programmer Board KF (P/N 1169-4068).

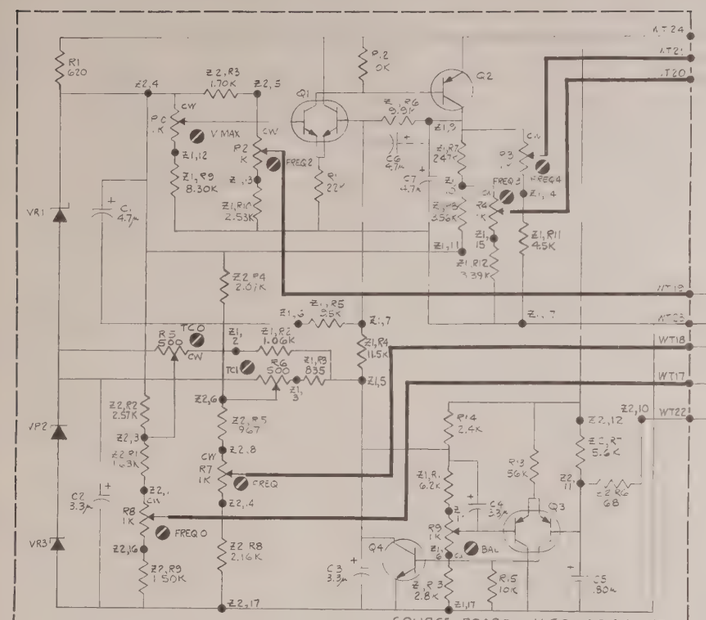


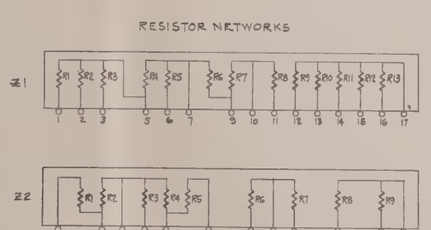
Etched-circuit diagram 100-MHz Step Programmer Board KE (P/N 1169-4074).

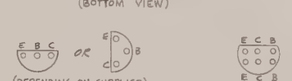
ELECTRICAL PARTS LIST

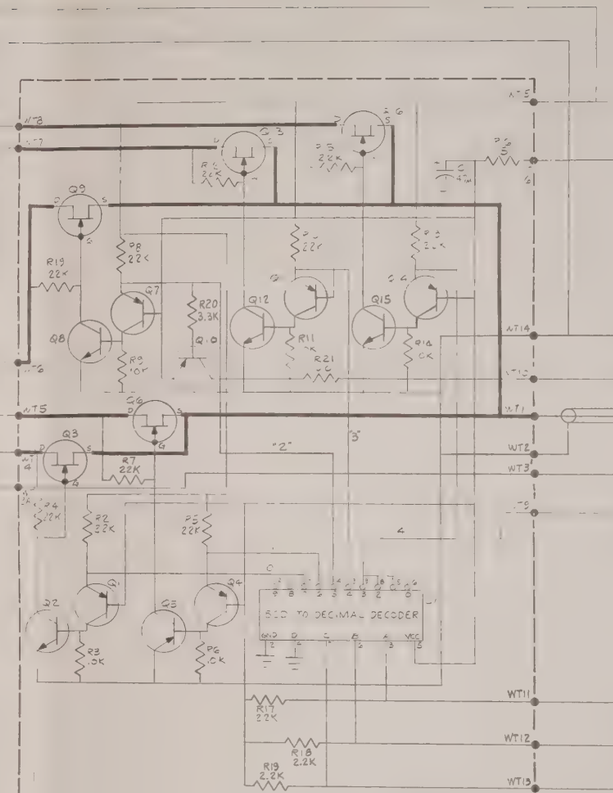
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.
	1169-4180 MICROWAVE ASM. COMPLETE (K)			
	CAPACITORS			
C14 thru C16	Ceramic, Feed-Thru, 500 pF, +100-0%	4400-2010	72982	2424-002
C78	Tantalum, 100μF ±2% 20 V	4450-4253	90201	TDC 100μF ±2%
C79	Ceramic, 0.1μF ±10% 100 V	4400-6350	72982	8131 0.1μF ±10%
C80 and C81	Ceramic, 2.2μF ±20% 50 V	4400-2080	72982	8141 2.2μF ±20%
C90 thru C92	Ceramic, 2.2μF ±20% 50 V	4400-2080	72982	8141 2.2μF ±20%
	CONNECTOR			
	Asm., Jack 50Ω	4260-1180	01488	2058-5027
	1169-2794			
C1 thru C7	Feed-Thru, 1000 pF, +100-0%	4400-2200	QJ121	FASC 1000 pF +100-0%

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.









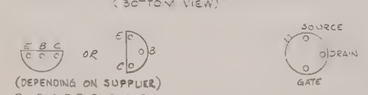


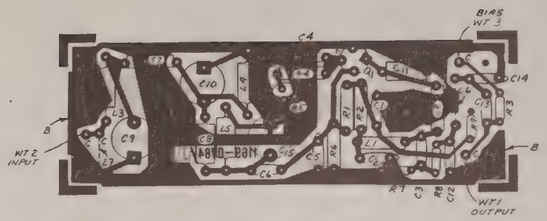
Figure 6-33. 100-MHz step programmer KE/K (P/N 1169-4074/-406

ELECTRICAL PARTS LIST

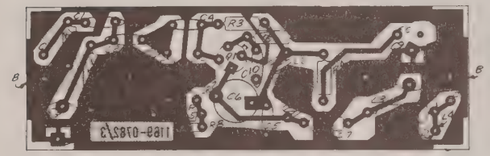
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
	1169-4082 100/200 MHz GENERATOR BOARD (KG)				
	CAPACITORS				
C1	Ceramic, 2.7 pF ±5% 500 V	4411-9275	80131	CC60, 2.7 pF ±5%	
C2	Ceramic, 8.2 pF ±5% 500 V	4411-9825	80131	CC60, 8.2 pF ±5%	
C3	Trimmer Ceramic, PC 5.5-18 pF	4910-1201	72982	538-011, 5.5-18 pF	
C4	Ceramic, 100 pF +80-20% 500 V	4404-1109	72982	831, 100 pF +80-20%	
C5	Ceramic, .01 μF +80-20% 100 V	4401-3100	80131	CC61, .01 μF +80-20%	5910-974-5697
C6	Trimmer Ceramic, PC 7-25 pF	4910-1200	72982	538-011, 7-25 pF	
C7	Ceramic Tubular, .47 pF ±10% 500 V	4400-1201	78488	GA, .47 pF ±10%	
C9	Trimmer Ceramic, PC 5.5-18 pF	4910-1201	72982	538-011, 5.5-18 pF	
C10	Ceramic, .01 μF +80-20% 100 V	4401-3100	80131	CC61, .01 μF +80-20%	5910-974-5697
	INDUCTORS				
L1	Choke Molded, .15 μH ±10%	4300-0101	99800	1536, .15 μH ±10%	
L2	Coil	1169-6033	24655	1169-6033	
L3	Choke Molded, .15 μH ±10%	4300-0101	99800	1536, .15 μH ±10%	
L4	Wire	5080-1267	24655	5080-1267	
	RESISTORS				
R1	Comp., 270 Ω ±5% 1/4 W	6099-1275	75042	BTS, 270 Ω ±5%	
R2	Comp., 1.5 kΩ ±5% 1/4 W	6099-2155	75042	BTS, 1.5 kΩ ±5%	
R3	Comp., 27 kΩ ±5% 1/4 W	6099-3275	75042	BTS, 27 kΩ ±5%	
R4	Comp., 100 Ω ±5% 1/4 W	6099-1105	00912	CB, 100 Ω ±5%	
R5	Comp., 4.7 kΩ ±5% 1/4 W	6099-2475	00912	CB, 4.7 kΩ ±5%	
R6	Comp., 150 Ω ±5% 1/4 W	6099-1155	75042	BTS, 150 Ω ±5%	5905-683-2243
R7	Comp., 680 Ω ±5% 1/4 W	6099-1685	75042	BTS, 680 Ω ±5%	
	THERMISTOR				
R8		6740-1603	15801	JB31J7	
	TRANSISTOR				
Q1	Type 2N3933	8210-1122	79089	2N3933	
	1169-4084 100/200 MHz OUTPUT BOARD (KH)				
	CAPACITORS				
C1 thru C4	Ceramic, .01 μF +80-20% 100 V	4401-3100	80131	CC61, .01 μF +80-20%	5910-974-5697
C5	Ceramic, 5.1 pF ±5% 500 V	4411-9515	80131	CC60, 5.1 pF ±5%	
C6	Ceramic, 8.2 pF ±5% 500 V	4411-9825	80131	CC60, 8.2 pF ±5%	
C7 and C8	Ceramic Tubular, 47 pF ±10% 500 V	4400-1200	78488	GA, .47 pF ±10%	
C9 and C10	Trimmer, Ceramic, PC 5.5-18 pF	4910-1201	72982	538-011, 5.5-18 pF	
C11	Trimmer, Ceramic, 2-8 pF	4910-1202	7298	538-011, 2-8 pF	
C12	Ceramic, 10 pF ±10% 500 V	4404-0108	72982	831, 10 pF ±10%	
C13	Ceramic, .01 μF +80-20% 100 V	4401-3100	80131	CC61, .01 μF +80-20%	5910-974-5697
C14	Ceramic, 10 pF ±10% 500 V	4404-0108	72982	831, 10 pF ±10%	
C15	Trimmer, Ceramic, PC 5.5-18 pF	4910-1201	72982	538-011, 5.5-18 pF	
	INDUCTORS				
L1	Choke Molded, .10 μH ±10%	4300-7555	99800	1025 .10 μH ±10%	
L2	Choke Molded, .15 μH ±10%	4300-7553	99800	1025 .15 μH ±10%	
L3 thru L5	Choke Molded, .15 μH ±10%	4300-0101	99800	1536 .15 μH ±10%	
L6	Coil	1169-8460	24655	1169-8460	
	RESISTORS				
R1	Comp., 10 kΩ ±5% 1/4 W	6099-3105	75042	BTS, 10 kΩ ±5%	5905-683-2238
R2	Comp., 56 Ω ±5% 1/4 W	6099-0565	75042	BTS, 56 Ω ±5%	
R3	Comp., 360 Ω ±5% 1/8 W	6098-1365	01121	BB, 360 Ω ±5%	
R4	Comp., 62 Ω ±5% 1/4 W	6099-0625	75042	BTS, 62 Ω ±5%	
R5	Pot. Comp., 1 kΩ ±20%	6049-0106	80294	3006P-1-13	
R6	Comp., 1.2 kΩ ±5% 1/4 W	6099-2125	75042	BTS, 1.2 kΩ ±5%	
R7	Comp., 330 Ω ±5% 1/8 W	6098-1335	01121	BB, 330 Ω ±5%	
R8	Comp., 18 Ω ±5% 1/8 W	6098-0185	01121	BB, 18 Ω ±5%	
R9	Comp., 56 Ω ±5% 1/8 W	6098-0565	01121	BB, 56 Ω ±5%	
	TRANSISTORS				
Q1		8210-1228	73445	A430	

ELECTRICAL PARTS LIST

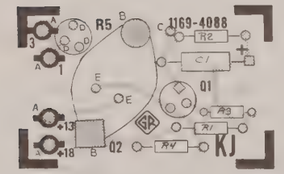
Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
	1169-4088 +13 V REGULATOR BOARD (KJ)				
	CAPACITORS				
C1	Tantalum, 18 μF, ±20%, 15 V	4450-5230	56289	150-D	
	RESISTORS				
R1	Film, 5.11 kΩ, ±1%, 1/8 W	6250-1511	75042	CEA, 5.11 kΩ, ±1%	5905-577-6734
R2	Film, 12.4 kΩ, ±1%, 1/8 W	6250-2124	75042	CEA, 12.4 kΩ, ±1%	
R3	Comp., 1 kΩ, ±5%, 1/4 W	6099-2105	75042	BTS, 1 kΩ, ±5%	5905-681-6422
R4	Comp., 680 Ω, ±5%, 1/2 W	6100-1685	01121	RC20GF681J	5905-195-6791
R5	Pot, Cermet, 5 kΩ, ±20%	6049-0108	80294	3329H-1-502	
R6	Pot, Cermet, 500 Ω, ±20%	6049-0105	80294	3329H-1-501	
	TRANSISTORS				
Q1	Type 2N3905	8210-1114	04713	2N3905	
Q2	Type 40250	8210-1095	79089	40250	



Etched-circuit diagram 100/200-MHz Output Board (P/N 1169-4084).



Etched-circuit diagram 100-MHz Generator Board (P/N 1169-4082).



Etched-circuit diagram +13-V Regulator Board (P/N 1169-4088).

NOTE: The board is shown parts side up, with the foil tracks for the parts side shaded. Foil on the opposite side is shown solid. The square pad denotes: + end of capacitors, cathode end of diodes, pin 1 of IC's, and collector of transistors. The part number for the board is given in the caption.

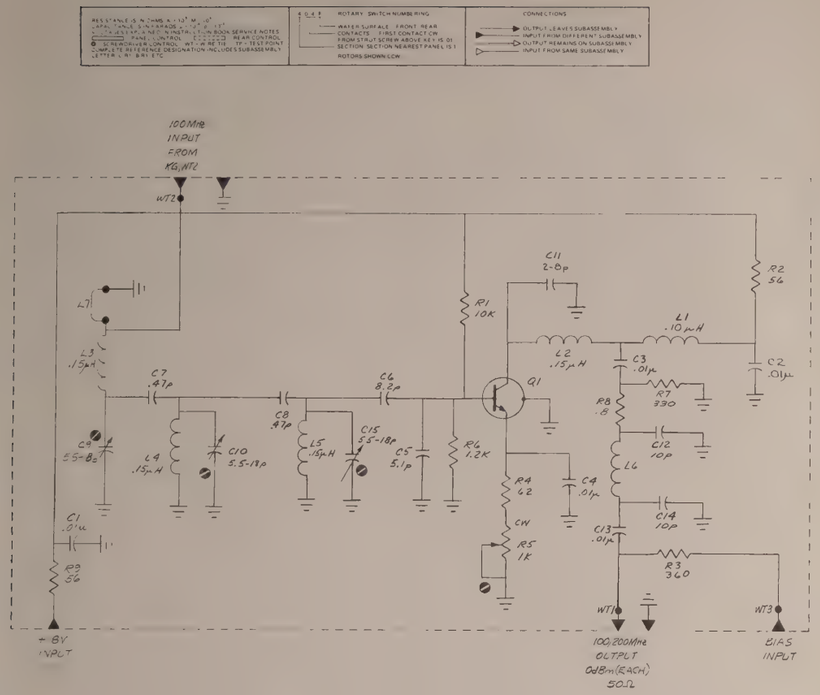
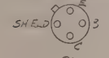
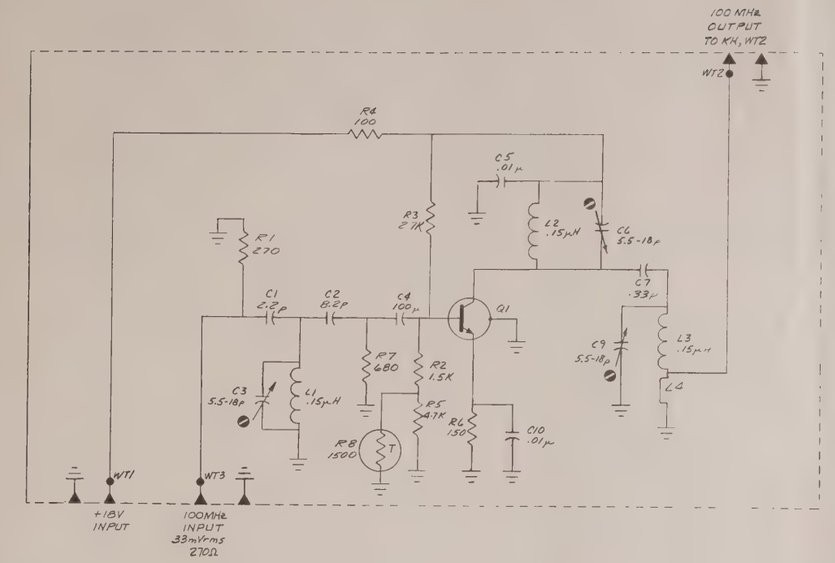


Figure 6-34. Part 1. 100/200 MHz Output KH. (P/N 1169-4084)

TRANSISTOR BASING DIAGRAM (BOTTOM VIEW)



COMPONENTS USED:
CAPACITORS: C1 THRU C15
RESISTORS: R1 THRU R9
TRANSISTOR: T1
INDUCTORS: L1 THRU L7



TRANSISTOR BASING DIAGRAM (BOTTOM VIEW)

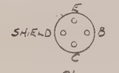
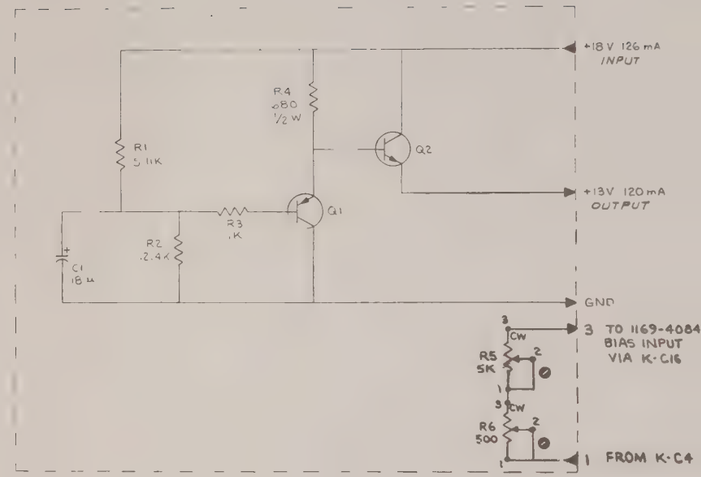


Figure 6-34. Part 2. 100 MHz Generator KG. (P/N 1169-4082)



TRANSISTOR BASE DIAGRAMS (BOTTOM VIEW)

Figure 6-34. Part 3. +13 V Regulator KJ. (P/N 1169-4088)

ELECTRICAL PARTS LIST

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4181 OUTPUT MIXER ASM (KA)					
CONNECTORS					
	Coax. Insulator	4230-1230	24655	4230-1230	
J1 and J2	Coax, Shell	4230-1220	24655	4230-1220	
J3	Coax, Shell	4230-1220	24655	4230-1220	
DIODES					
	Matched Quad Asm	1711-2300	24655	1711-2300	
FILTERS					
Z1 thru Z4	Elec. L.P. 100 MHz	5280-1253	16546	3223-000	
RESISTORS					
R9	Comp., 220 Ω ±5% 5 W	6100-1225	01121	RC20GF221J	5905-279-3513
TRANSISTORS					
Q1	Type 358822E	8210-0003	12064	35822E	
1169-4182 ISOLATION AMPLIFIER ASM (KB)					
CONNECTORS					
	Coax. Insulator	4230-1230	24655	4230-1230	
J10 and J11	Coax, Shell	4230-1220	24655	4230-1220	
J12 and J13	Coax, Shell	4230-1220	24655	4230-1220	
DIODES					
	Matched Quad Asm	1711-2300	24655	1711-2300	
FILTERS					
Z10 thru Z13	Elec. L.P. 100 MHz	5280-1253	16546	3223-000	
TRANSISTORS					
Q1	Type 35822E	8210-0003	12064	35822E	
1169-4183 2225 MHz BPF (KC)					
CAPACITORS					
C1	15 μF 20 V	4450-5200	56289	150D156X0020B2	5910-855-6335
CONNECTORS					
	Coax. Insulator	4230-1230	24655	4230-1230	
J21 and J22	Coax, Shell	4230-1220	24655	4230-1220	
J23 and J24	Coax, Shell	4230-1220	24655	4230-1220	
J25	Coax, Shell	4230-1220	24655	4230-1220	
DIODES					
CR20 and CR21	Type IN3604	6082-1001	2446	IN3604	5961-995-2199
	Matched Quad Asm	1711-2300	24655	1711-2300	
FILTERS					
Z21 thru Z24	Elec. L.P. MHz	5280-1253	16546	3223-000	
Z25	Elec. L.P. 200 MHz	5280-1254	16546	3223-000	
TRANSISTORS					
Q1	Type 35822E	8210-0003	12064	35822E	

ELECTRICAL PARTS LIST (cont)

Ref Des	Description	GR Part No.	Fed Mfg Code	Mfg Part No.	Fed Stock No.
1169-4184 1720 MHz BPF ASM (KD)					
CONNECTORS					
	Coax, Insulator	4230-1230	24655	4230-1230	
J30 and J31	Connector, Coax, Shell	4230-1220	24655	4230-1220	
J32 and J33	Connector, Coax, Shell	4230-1220	24655	4230-1220	
DIODES					
	Matched Quad Asm	1711-2300	24655	1711-1300	
FILTERS					
Z31 thru Z34	Elec. L.P. 100 MHz	5280-1253	16546	3223-000	
TRANSISTORS					
Q1	Type 35822E	8210-0003	12064	35822E	

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